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In the Supreme Court of the United States

MICHIGAN, ET AL., PETITIONERS
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

UTILITY AIR REGULATORY GROUP, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

NATIONAL MINING ASSOCIATION, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

ON WRITS OF CERTIORARI
TO THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

JOINT APPENDIX – VOLUME 1 OF 4

Donald B. Verrilli, Jr.
Solicitor General
Counsel of Record
Department of Justice
Washington, D.C.
20530-0001
SupremeCtBriefs@usdoj.gov
(202) 514-2217

Aaron D. Lindstrom
Solicitor General
Counsel of Record
P.O. Box 30212
Lansing, Michigan 48909
LindstromA@michigan.gov
(517) 373-1124

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Melissa Hoffer
Counsel of Record
Assistant Attorney General
Environmental Protection Division
One Ashburton Place
18th Floor
Boston, MA 02130
melissa.hoffer@state.ma.us
(617) 963-2322

Brendan K. Collins
Counsel of Record
Ballard Spahr LLP
1735 Market Street
51st Floor
Philadelphia, PA 19103
collins@ballardspahr.com
(215) 665-8500

Sean H. Donahue
Counsel of Record
Donahue & Goldberg LLP
1130 Connecticut Ave., NW
Suite 950
Washington, D.C. 20036
sean@donahuegoldberg.com
(202) 277-7085

F. William Brownell
Counsel of Record
Hunton & Williams LLP
2200 Pennsylvania Ave., NW
Washington, D.C. 20037
bbrownell@hunton.com
(202) 955-1500

Peter S. Glaser
Counsel of Record
Troutman Sanders LLP
401 Ninth Street, NW
Suite 1000
Washington, D.C. 20004
Peter.glaser@troutmansanders.com
(202) 274-2998

TABLE OF CONTENTS

VOLUME 1 OF 4

Relevant Docket Entries
White Stallion Energy Center v. *EPA*
Court of Appeals
Docket No. 12-1100 1–26

U.S. EPA, Mercury Study Report to Congress,
Vol. 1: Executive Summary, EPA-452/R-97-003
Docket No. EPA-HQ-OAR-2009-0234-3054
December 1997

Excerpts

Overview [pp. O-1 to O-4] 27–35

Report to Congress [pp. 1-1 to 1-3] 36–43

[pp. 4-1 to 4-10] 44–60

EPA Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress, Volume 1
Docket No. EPA-HQ-OAR-2009-0234-3052
February 1998

Excerpts

Executive Summary
[pp. ES-1 to ES-29] 61–114

Utility Study Section 2.7 [p. 2-25] 115–116

Title I and Title IV,
Phase I and Phase II,
Compliance Strategy Impact
[pp. 2-31 to 2-32] 117–119

6.0 Inhalation Risk Assessment
[pp. 6-1 to 6-7] 120–131

Table 7-1 [pp. 7-8] 132–134

Areas for Further Research and Analysis
[pp. 14-8 to 14-10] 135–138

69 Fed. Reg. 4652
January 30, 2004
[pp. 4657 to 4659] 139–145

70 Fed. Reg. 15994
March 29, 2005
Sections F & G
[pp. 16019 to 16022] 146–162

Coal-to-Gas Conversion TSD,
EPA-HQ-OAR-2009-0234-3065
March 4, 2011 163–166

Memo, "National Emission Standards for Hazardous Air Pollutants (NESHAP) Beyond the Maximum Achievable Control Technology (MACT) Floor Analysis for Coal- and Oil-fired Electric Utility Steam Generating EGUs"
EPA-HQ-OAR-2009-0234-2924
March 14, 2011 167–179

National Mining Association's Comments
Docket No. EPA-HQ-2009-0234 (NESHAP action) and EPA-HQ-OAR-2011-0044 (NSPS)
76 Federal Register 24,976
May 3, 2011
Excerpt
[pp. 26 to 27] 180–185

Connecticut Department of Energy and Environmental Protection comments
EPA-HQ-OAR-2009-0234-20298
July 12, 2011
Excerpts
Cover letter and attachment
[pp. 1 to 2] 186–193

South Carolina Department of Health and Environmental Control comments
EPA-HQ-OAR-2011-0444-5749
July 20, 2011 194–213

Massachusetts Department of Environmental Protection comments
EPA-HQ-OAR-2009-0234-18039
July 29, 2011

Excerpts

[pp. 1 to 4] 214–218

[pp. 6 to 7] 219–227

New England Interstate Water Pollution Control Commission comments
EPA-HQ-OAR-2009-0234-17625
August 2, 2011 228–231

Northeast States for Coordinated Air Use Management comments
EPA-HQ-OAR-2009-0234-17843
August 2, 2011

Excerpts

[pp. 1 to 10] 232–252

Attachment A (table) [pp. A-1 to A-2] ... 253–254

VOLUME 2 OF 4

Michigan Department of Environmental Quality comments, EPA-HQ-0234-2009-0234-18426
August 3, 2011 255–277

National Association of Clean Air Agencies comments, EPA-HQOAR-2009-0234-17620
August 4, 2011

Excerpts

Cover letter and comments [pp. 1 to 10] 278–305

Attachment 1 (table) [pp. 1 to 15] 306–320

New Jersey Department of Environmental Protection, comments EPAHQ-OAR-2009-0234-18444
August 4, 2011

Excerpts

[pp. 1 to 2] 321–323

[pp. 4 to 5] 324–327

[pp. 9 to 10] 328–329

Comments of Environmental and Public Health Groups on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule. Docket No. EPA-HQ-OAR-2011-0044-5715
August 4, 2011

Excerpt

Chapter I [pp. I-1 to I-38]..... 330–382

Comments of Environmental Defense Fund on the National Emission Standards for Hazardous Air Pollutants From Coal-and Oil-Fired Electric Utility Steam Generating Units, Docket No. EPA-HQ-OAR-2009-0234-18421
August 4, 2011

Excerpt

Part I [pp. 3 to 7]..... 383–392

EPRI Comments on Proposed HAPs MACT Rule
EPA-HQ-2009-0234-17621
August 4, 2011

Excerpts

Specific Comments on the Environmental Fate and Transport, Exposure and Human Health Issues, and Risk Analyses [p. viii to x] 393–399

EPRI's comprehensive sector-wide inhalation risk assessment on all 470 coal-fired generating facilities identified no cancer or non-cancer health risks above regulatory risk threshold, in contrast to EPA's 16 case studies assessment
[pp. 3-22 to 3-27] 399–411

[pp. 3-46 to 3-48] 412–418

[pp. 3-53 to 3-56] 419–422

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17648, Part 1 of 3
August 4, 2011

Excerpts

Comment 1, Sections 1.1 through 1.2
[pp. 6 to 12] 423–436

Comment 2, Sections 2.1 through 2.3
[pp. 21 to 38] 436–468

Comment 3, entire
[pp. 38 to 53]..... 468–497

Comment 4, entire
[pp. 54 to 56]..... 497–503

Comment 5
[pp. 56 to 71]..... 503–532

Comment 7, Section 7.5
[pp. 88 to 90]..... 532–536

Comment 7, Section 7.7
[pp. 92 to 94]..... 536–539

Exhibit 2, MJ Bradley & Associates LLC and Analysis Group, "Ensuring a Clean, Modern, Electric Generating Fleet while Maintaining Electric System Reliability" (Aug. 2010) – Entire report, no attachments [pp. 1 to 24]..... 540–590

Exhibit 4, NESCAUM Report, "Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants" (Mar. 31, 2011) – Executive Summary
[pp. 1 to 4]..... 591–600

Exhibit 7, URS Report – Entire report, no appendices
[pp. 1 to 15]..... 601–624

VOLUME 3 OF 4

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule
Docket No. EPA-HQ-OAR-2009-0234-17651
Part 2 of 3
August 4, 2011

Excerpts

Exhibit 10, MJ Bradley Report Update – Entire report [pp. 1 to 20] 625–665

Exhibit 11, Tierney and Cicchetti Peer Review of EEI Report – Entire report [pp. 1 to 13] 666–685

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17650, Part 3 of 3
August 4, 2011

Excerpts

Exhibit 21 – Cicchetti Report – Entire report [pp. 1 to 50] 686–754

Exhibit 23 – Environmental Health & Engineering Inc. Report – Executive Summary and Sections 1.0 to 3.3 [pp. 1 to 22] 755–796

VOLUME 4 OF 4

New York Department of Environmental Conservation comments,
EPA-HQ-OAR-2009-0234-17796
August 4, 2011

Excerpts

Cover letter 797–801

Enclosure A [pp. 1 to 2] 802–806

Comments of the Utility Air Regulartory Group
August 4, 2011

Excerpts

Attachment 15 [pp. 6, 12, 15, 16] 807–810

Letter from Dr. Deborah Swackhamer and Dr. Stephen Roberts, Science Advisory Board to Lisa Jackson, Administrator, U.S. EPA,
EPA-OAR-2009-0234-18487 – Text only
Sept. 29, 2011 811–814

Supplement to the Non-Hg Case Study Chronic Inhalation Risk Assessment In Support of the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units
EPA-HQ-OAR-2009-0234-19912
November 2011

Excerpts

3. Chronic Inhalation Risk Assessment [p. 10 to 12]..... 815–817

3. Results [p. 12]..... 818

Table 9 [p. 13]..... 819–820

==========

Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard, EPA-454/R-11-014
November 2011

Excerpts

All title pages and text pages [pp. 1 to 3]..... 821–829

==========

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 1 of 2
December 2011

Excerpts

Response to comment 25 [p. 13]..... 830

2. Consideration of both public health and environmental effects [pp. 23 to 29] 831–847

a. Agreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [p. 39] 847

b. Disagreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [pp. 39 to 41] 847–853

c. Agreement that EGUs were properly listed under CAA section 112(c)(1) and may not be delisted because they do not meet the delisting criteria in CAA section 112(c)(9). [pp. 52 to 54] 853–858

9. Consideration of criteria pollutants under Appropriate and Necessary Finding [pp. 55 to 59] 858–867

Response to comments 1 – 3 [p. 77] 867–869

Comment 9 and Response [pp. 79 to 81] 869–874

Response to Comment 30 [pp. 435] 874–875

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 2 of 2
December 2011

Excerpts

Response to Comments 49-50
[p. 322] 876–877

Response to Comments 52-62
[pp. 328-331] 878–884

Impacts and Costs Analysis, Comment 1 and response [p. 477] 885

Impacts and Costs Analysis, Comment 5 and response [p. 478] 885–886

Impacts and Costs Analysis, Comment 10 and response [pp. 482 to 484] 886–890

Impacts and Costs Analysis, Comments 6 to 10 and responses [pp. 627 to 630] 890–899

Impacts and Costs Analysis, Comment 11 and response [pp. 630 to 631] 899–902

Impacts and Costs Analysis, Comment 12 and response [pp. 631 to 632] 902–903

Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards
EPA-HQ-OAR-2009-0234-20131
December 2011

Excerpts

Executive Summary, ES.1
[p. ES-1, Table ES-1] 904–907

Executive Summary, ES.1.1, Health Co-Benefits
[pp. ES-3 to ES-4] 908–911

Executive Summary, ES.1.2, Welfare Co-Benefits
[pp. ES-4 to ES-5] 911–912

Executive Summary, ES.2, Tables ES-5, ES-6, Not All Benefits Quantified
[pp. ES-9 to ES-13] 913–923

[pp. 3-10] 924–925

[pp. 3-33] 926–927

[pp. 5-15] 928–929

Chapter 4, Section 4.2 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Human Health) [pp. 4-3 to 4-5] 930–933

Chapter 4, Section 4.3 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Ecosystems and Wildlife) [pp. 4-6 to 4-9] 934–940

Chapter 4, Section 4.8.5.6 (Mercury and Other HAP Benefits Analysis/Unquantified Benefits)
[pp. 4-64 to 4-66] 940–944

Chapter 4, Section 4.9 (Mercury and Other HAP Benefits Analysis/Benefits Associated with Reductions in Other HAP than Mercury)
[pp. 4-68 to 4-73] 944–953

Chapter 5, Synopsis (Health and Welfare Co-Benefits) [p. 5-1] 954–955

Chapter 5, Section 5.5 (Health and Welfare Co-Benefits/Unquantified Health and Welfare Benefits)
[p. 5-59] 956

Memorandum, "The Environmental Protection Agency's Enforcement Response Policy for Use of Clean Air Act Section 113(a) Administrative Orders in Relation to Electric Reliability And The Mercury and Air Toxics Standard" (
December 16, 2011 957–970

Memo, "Emission Reduction Costs for Beyond-the-floor Mercury Rate for Existing Units Designed to Burn Low Rank Virgin Coal"
EPA-HQ-OAR-2009-0234-20130
December 16, 2011 971–976

Emission Reduction Costs for the Beyond-the-Floor Mercury Rate in the Toxics Rule
EPA-HQ-OAR-2009-0234-2925
Undated 977–981

The following opinions and order have been omitted in printing this Joint Appendix because they appear on the following pages in the appendix to the Petition for a Writ of Certiorari:

14-46 Michigan, et al. v. EPA, et al.

Federal Register
Volume 70, No. 59
March 29, 2005
Pages 16,000–01 ..... 116a–120a

Federal Register
Volume 76, No. 85
May 3, 2011
Pages 24,987–88 ..... 112a–115a

Federal Register
Volume 77, No. 32
February 16, 2012
Page 9,327 ..... 109a–111a

United States Court of Appeals
for the District of Columbia Circuit
Opinion in 12-1100
issued April 15, 2014 ..... 1a–105a

14-47 UARG v. EPA, et al.

APPENDIX J: U.S. Environmental Protection Agency, EPA-453/R-98-004a, Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units -- Final Report to Congress, Vol. 1 (Feb. 1998), Docket No. EPA-HQ-OAR-2009-0234-3052 (excerpts) 636a

APPENDIX I: U.S. Environmental Protection Agency, Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units; Notice of Regulatory Finding, 65 Fed. Reg. 79,825 (Dec. 20, 2000) 610a

APPENDIX H: U.S. Environmental Protection Agency, Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List; Final Rule, 70 Fed. Reg. 15,994 (Mar. 29, 2005)(excerpt)..... 544a

APPENDIX F: Utility Air Regulatory Group, Comments on National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units: Proposed Rule (Aug. 4, 2011), Docket No. EPA-HQ-OAR-2009-0234-17775 (excerpts)..... 510a

APPENDIX G: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Proposed Rule, 76 Fed. Reg. 24,976 (May 3, 2011) (excerpts) 514a

APPENDIX E: EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units, Vol. 1 (Dec. 2011), Docket No. EPA-HQ-OAR-2009-0234-20126 (excerpts)..... 506a

APPENDIX C: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final Rule, 77 Fed. Reg. 9304 (Feb. 16, 2012) (excerpts) 105a

APPENDIX B: Opinion of the U.S. Court of Appeals for the District of Columbia Circuit.. 3a

APPENDIX A: Order of the U.S. Court of Appeals for the District of Columbia Circuit Denying All Petitions for Review, Except the Petition for Review in No. 12-1174, and Dismissing That Petition 1a

14-49 NMA v. EPA, et al.

APPENDIX F: Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units (excerpts)..... 1937a

APPENDIX E: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, Proposed Rule 76 Fed. Reg. 24,976 (May 3, 2011)..... 1161a

APPENDIX D: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional SteamGenerating Units, 77 Fed. Reg. 9,305 (Feb. 16 2012) 196a

APPENDIX B: In the United States Court of Appeals for the District of Columbia Circuit – Judgment (Apr. 15, 2014) 99a

APPENDIX A: In the United States Court of Appeals for the District of Columbia Circuit – Opinion (Apr. 15, 2014) 1a

Relevant Docket Entries from the United States Court of Appeals for District of Columbia Circuit
Docket No. 12-1100

White Stallion Energy Center v. EPA

Appeal From: Environmental Protection Agency

District: EPA-1; EPA-77FR9304

Consolidation

Lead	Member	Start
12-1100	12-1101	02/22/2012
12-1100	12-1102	02/22/2012
12-1100	12-1147	03/16/2012
12-1100	12-1172	04/19/2012
12-1100	12-1173	04/19/2012
12-1100	12-1174	04/19/2012
12-1100	12-1175	04/19/2012
12-1100	12-1176	04/19/2012
12-1100	12-1177	04/19/2012
12-1100	12-1178	04/19/2012
12-1100	12-1180	04/19/2012
12-1100	12-1181	04/19/2012

Consolidation

Lead	Member	Start
12-1100	12-1182	04/19/2012
12-1100	12-1183	04/19/2012
12-1100	12-1184	04/19/2012
12-1100	12-1185	04/19/2012
12-1100	12-1186	05/30/2012
12-1100	12-1187	04/19/2012
12-1100	12-1188	04/23/2012
12-1100	12-1189	04/23/2012
12-1100	12-1190	04/19/2012
12-1100	12-1191	04/19/2012
12-1100	12-1192	05/30/2012
12-1100	12-1193	04/19/2012
12-1100	12-1194	04/19/2012
12-1100	12-1195	04/19/2012
12-1100	12-1196	04/24/2012
12-1166	12-1366	08/24/2012
12-1166	12-1420	10/18/2012

Related

Lead	Member	Start
12-1100	12-1166	08/24/2012

Date of Hearing: 12/10/2013

Date of Decision: 04/15/2014

Date Completed: 04/15/2014

* * *

02/16/2012
PETITION FOR REVIEW filed [1358855] by White Stallion Energy Center, LLC of a decision by federal agency [Service Date: 02/16/2012] Disclosure Statement: Attached; Certificate of Parties: Not Applicable to this Filing [12-1100]

02/16/2012
PETITION FOR REVIEW filed [1358862] by National Mining Association of a decision by federal agency [Service Date: 02/16/2012] Disclosure Statement: Attached; Certificate of Parties: Not Applicable to this Filing [12-1101]

03/16/2012
PETITION FOR REVIEW filed [1364222] by Utility Air Regulatory Group of a decision by federal agency [Service Date: 03/16/2012] Disclosure Statement: Attached; Certificate of Parties: Not Applicable to this Filing [12-1147]

04/16/2012
PETITION FOR REVIEW filed [1369112] by Railroad Commission of Texas, State of Texas, Texas Commission on Environmental Quality and Texas Public Utility Commission of a decision by federal agency [Service Date: 04/13/2012] Disclosure Statement: Not Attached; Certificate of Parties: Not Applicable to this Filing [12-1185]

04/16/2012
PETITION FOR REVIEW filed [1369098] by State of Arkansas of a decision by federal agency [Service Date: 04/16/2012] Disclosure Statement: Not Applicable to this Party; Certificate of Parties: Not Applicable to this Filing [12-1190]

04/16/2012
PETITION FOR REVIEW filed [1369346] by Terry E. Branstad, Commonwealth of Pennsylvania, Commonwealth of Virginia, Jack Conway, State of Alabama, State of Alaska, State of Arizona, State of Florida, State of Idaho, State of Indiana, State of Kansas, State of Michigan, State of Mississippi, State of Missouri, State of Nebraska, State of North Dakota, State of Ohio, State of Oklahoma, State of South Carolina, State of Utah, State of West Virginia and State of Wyoming of a decision by federal agency [Service Date: 04/16/2012] Disclosure Statement: Not Applicable to this Party; Certificate of Parties: Not Applicable to this Filing [12-1196]

04/27/2012
UNDERLYING DECISION IN CASE submitted [1371244] by White Stallion Energy Center, LLC [Service Date: 04/27/2012] [12-1100] (Marwell, Jeremy)

06/11/2012
CERTIFIED INDEX TO RECORD [1377996] by EPA in 12-1100, 12-1101, 12-1102, 12-1147, 12-1166, 12-1170, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1183, 12-1184, 12-1182, 12-1190, 12-1191, 12-1185, 12-1187, 12-1193, 12-1194, 12-1186, 12-1188, 12-1189, 12-1192, 12-1195, 12-1196 [Service Date: 06/11/2012] [12-1100, 12-1101, 12-1102, 12-1147, 12-1166, 12-1170, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Hostetler, Eric)

PETITIONER BRIEF [1401247] filed by American Public Power Association in 12-1173, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, Chase Power Development, LLC in 12-1191, Oak Grove Management Company, LLC in 12-1187, Kansas City Board of Public Utilities in 12-1186, Gulf Coast Lignite Coalition in 12-1188, Puerto Rico Electric Power Authority in 12-1189, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195 [Service Date: 10/23/2012] Length of Brief: 3,990 words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1170, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Holmstead, Jeffrey)

10/23/2012

PETITIONER BRIEF [1401252] filed by White Stallion Energy Center, LLC in 12-1100, National Mining Association in 12-1101, Institute for Liberty and National Black Chamber of Commerce in 12-1102, Utility Air Regulatory Group in 12-1147, Midwest Ozone Group in 12-1172, American Public Power Association in 12-1173, Peabody Energy Corporation in 12-1175, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, United Mine Workers of America in 12-1183, Georgia Association of Manufacturers, Inc., Indiana Chamber of Commerce, Inc., Indiana Coal Council, Inc., Kentucky Chamber of Commerce, Inc., Kentucky Coal Association, Inc., North Carolina Chamber, Ohio Chamber of Commerce, Pennsylvania Coal Association, South Carolina Chamber of Commerce, The Virginia Chamber of Commerce, The Virginia Coal Association, Incorporated, West Virginia Chamber of Commerce, West Virginia Coal Association, Inc. and Wisconsin Industrial Energy Group, Inc. in 12-1182, State of Arkansas in 12-1190, Chase Power Development, LLC in 12-1191, Railroad Commission of Texas, State of Texas, Texas Commission on Environmental Quality and Texas Public Utility Commission in 12-1185, Edgecombe Genco, LLC and Spruance Genco, LLC in 12-1193, Kansas City Board of Public Utilities in 12-1186, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195, Terry E. Branstad, Commonwealth of Pennsylvania, Commonwealth of Virginia, John William Conway, State of Alabama, State of Alaska, State of Arizona, State of Florida, State of Idaho, State of Indiana, State of Kansas, State of Michigan, State of

Mississippi, State of Missouri, State of Nebraska, State of North Dakota, State of Ohio, State of Oklahoma, State of South Carolina, State of Utah, State of West Virginia and State of Wyoming in 12-1196 [Service Date: 10/23/2012] Length of Brief: 14,879 words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1170, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Brownell, F.)

10/23/2012
PETITIONER BRIEF [1401254] filed by Chesapeake Climate Action Network, Conservation Law Foundation, Environmental Integrity Project and Sierra Club in 12-1194 [Service Date: 10/23/2012] Length of Brief: 5,961 words. [12-1194, 12-1100] (Pew, James)

10/24/2012
PETITIONER BRIEF [1401322] filed by Julander Energy Company in 12-1174 [Service Date: 10/24/2012] Length of Brief: 1496 words. [12-1100, 12-1174] (Bookbinder, David)

10/30/2012
AMICUS FOR PETITIONER BRIEF [1402141] filed by Chamber of Commerce of the United States of America in 12-1100, 12-1101, 12-1102, 12-1147, 12-1170, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1183, 12-1184, 12-1182, 12-1190, 12-1191, 12-1185, 12-1187, 12-1193, 12-1194, 12-1186, 12-1188, 12-1189, 12-1192, 12-1195, 12-1196 [Service Date: 10/30/2012] Length of Brief: 6767 words. [12-1100, 12-1101, 12-

1102, 12-1147, 12-1170, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Wigmore, Michael)

01/22/2013
RESPONDENT BRIEF [1416613] filed by EPA in 12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, EPA and Lisa Perez Jackson in 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1183, 12-1184, 12-1182, 12-1190, 12-1191, 12-1185, 12-1187, 12-1193, 12-1194, 12-1186, 12-1188, 12-1189, 12-1192, 12-1195, 12-1196 [Service Date: 01/22/2012] Length of Brief: 25,958. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Hostetler, Eric)

02/11/2013
PER ABOVE ORDER lodged Amicus brief [1417795-2] is filed [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

02/21/2013
JOINT INTERVENOR FOR RESPONDENT BRIEF [1421665] filed by Gulf Coast Lignite Coalition, Institute for Liberty, Lignite Energy Council, National Black Chamber of Commerce, National

Mining Association, Peabody Energy Corporation and Utility Air Regulatory Group in 12-1100, National Mining Association, Peabody Energy Corporation, Tri-State Generation and Transmission Association, Inc. and White Stallion Energy Center, LLC in 12-1174 [Service Date: 02/21/2013] Length of Brief: 937. [12-1100, 12-1174] (Glaser, Peter)

02/21/2013
JOINT INTERVENOR FOR RESPONDENT BRIEF [1421767] filed by City of Baltimore, City of Chicago, City of New York, County of Erie, New York, DC, State of California, State of Connecticut, State of Delaware, State of Illinois, State of Iowa, State of Maine, State of Maryland, State of Massachusetts, State of Minnesota, State of New Hampshire, State of New Mexico, State of New York, State of North Carolina, State of Oregon, State of Rhode Island and State of Vermont [Service Date: 02/21/2013] Length of Brief: 3065 words. [12-1100] (Triplett, Tracy)

02/21/2013
JOINT INTERVENOR FOR RESPONDENT BRIEF [1421806] filed by Calpine Corporation, Exelon Corporation, National Grid Generation, LLC and Public Service Enterprise Group, Inc. in 12-1100 [Service Date: 02/21/2013] Length of Brief: 3,118 Words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Collins, Brendan)

02/21/2013
INTERVENOR FOR RESPONDENT BRIEF [1421808] filed by American Academy of Pediatrics, American Lung Association, American Nurses Association, American Public Health Association, Chesapeake Bay Foundation, Inc., Citizens for Pennsylvania's Future, Clean Air Council, Conservation Law Foundation, Environment America, Environmental Defense Fund, Izaak Walton League of America, NAACP, Natural Resources Council of Maine, Natural Resources Defense Council, Ohio Environmental Council, Physicians for Social Responsibility, Sierra Club and Waterkeeper Alliance in 12-1100 [Service Date: 02/21/2013] Length of Brief: 3120 Words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Schroeder, Darin)

02/21/2013
JOINT INTERVENOR FOR RESPONDENT BRIEF [1421812] filed by Institute for Liberty, National Black Chamber of Commerce, National Mining Association, Peabody Energy Corporation, Sunflower Electric Power Corporation and Utility Air Regulatory Group in 12-1100, White Stallion Energy Center, LLC in 12-1194 [Service Date: 02/21/2013] Length of Brief: 3723 words. [12-1100, 12-1194] (Freeman, Lauren)

03/25/2013
PETITIONER REPLY BRIEF [1427247] filed by Chesapeake Climate Action Network, Conservation Law Foundation, Environmental Integrity Project and Sierra Club in 12-1194 [Service Date: 03/25/2013] Length of Brief: 2,988 Words. [12-1194] (Pew, James)

03/25/2013
JOINT PETITIONER REPLY BRIEF [1427259] filed by American Public Power Association in 12-1173, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, Chase Power Development, LLC in 12-1191, Oak Grove Management Company, LLC in 12-1187, Kansas City Board of Public Utilities in 12-1186, Gulf Coast Lignite Coalition in 12-1188, Puerto Rico Electric Power Authority in 12-1189, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195 [Service Date: 03/25/2013] Length of Brief: 2,000 Words. [12-1173, 12-1178, 12-1181, 12-1186, 12-1187, 12-1188, 12-1189, 12-1191, 12-1192, 12-1195] (Holmstead, Jeffrey)

03/25/2013
JOINT PETITIONER REPLY BRIEF [1427262] filed by White Stallion Energy Center, LLC in 12-1100, National Mining Association in 12-1101, Institute for Liberty and National Black Chamber of Commerce in 12-1102, Utility Air Regulatory Group in 12-1147, Midwest Ozone Group in 12-1172, American Public Power Association in 12-1173, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, United Mine Workers of

America in 12-1183, Georgia Association of Manufacturers, Inc., Indiana Chamber of Commerce, Inc., Indiana Coal Council, Inc., Kentucky Chamber of Commerce, Inc., Kentucky Coal Association, Inc., North Carolina Chamber, Ohio Chamber of Commerce, Pennsylvania Coal Association, South Carolina Chamber of Commerce, The Virginia Chamber of Commerce, The Virginia Coal Association, Incorporated, West Virginia Chamber of Commerce, West Virginia Coal Association, Inc. and Wisconsin Industrial Energy Group, Inc. in 12-1182, State of Arkansas in 12-1190, Chase Power Development, LLC in 12-1191, Railroad Commission of Texas, State of Texas, Texas Commission on Environmental Quality and Texas Public Utility Commission in 12-1185, Edgecombe Genco, LLC and Spruance Genco, LLC in 12-1193, Kansas City Board of Public Utilities in 12-1186, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195, Terry E. Branstad, Commonwealth of Pennsylvania, Commonwealth of Virginia, John William Conway, State of Alabama, State of Alaska, State of Arizona, State of Florida, State of Idaho, State of Indiana, State of Kansas, State of Michigan, State of Mississippi, State of Missouri, State of Nebraska, State of North Dakota, State of Ohio, State of Oklahoma, State of South Carolina, State of Utah, State of West Virginia and State of Wyoming in 12-1196 [Service Date: 03/25/2013] Length of Brief: 7,193 words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-

1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Brownell, F.)

03/28/2013
PETITIONER REPLY BRIEF [1427849] filed by Julander Energy Company in 12-1174 [Service Date: 03/28/2013] Length of Brief: 750 words. [12-1100, 12-1174] (Bookbinder, David)

04/01/2013
JOINT APPENDIX [1428379] filed [Volumes: 7] [Service Date: 04/01/2013] [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Brownell, F.)

04/05/2013
INTERVENOR FOR RESPONDENT FINAL BRIEF [1429198] filed by City of Baltimore, City of Chicago, City of New York, County of Erie, New York, DC, State of California, State of Connecticut, State of Delaware, State of Illinois, State of Iowa, State of Maine, State of Maryland, State of Massachusetts, State of Minnesota, State of New Hampshire, State of New Mexico, State of New York, State of North Carolina, State of Oregon, State of Rhode Island and State of Vermont in 12-1100 [Service Date: 04/05/2013] Length of Brief: 3065 words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Triplett, Tracy)

04/08/2013
INTERVENOR FOR RESPONDENT FINAL BRIEF [1429332] filed by Calpine Corporation, Exelon Corporation, National Grid Generation, LLC and Public Service Enterprise Group, Inc. in 12-1100 [Service Date: 04/08/2013] Length of Brief: 3,118 Words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Collins, Brendan)

04/08/2013
MODIFIED EVENT FROM FILED TO LODGED--SUPPLEMENTAL JOINT APPENDIX [1429356] LODGED [Volumes: 1] [Service Date:04/08/2013] [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]--[Edited 04/08/2013 by AY] (Oakes, Matthew)

04/08/2013
RESPONDENT FINAL BRIEF [1429467] filed by EPA in 12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1183, 12-1184, 12-1182, 12-1190, 12-1191, 12-1185, 12-1187, 12-1193, 12-1194, 12-1186, 12-1188, 12-1189, 12-1192, 12-1195, 12-1196 [Service Date: 04/08/2013] Length of Brief: 25,956 Words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183,

12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Hostetler, Eric)

04/08/2013
MODIFIED EVENT--INTERVENOR FOR RESPONDENT FINAL BRIEF [1429570] filed by Gulf Coast Lignite Coalition, Institute for Liberty, Lignite Energy Council, National Black Chamber of Commerce and Utility Air Regulatory Group in 12-1100, National Mining Association, Peabody Energy Corporation and Tri-State Generation and Transmission Association, Inc. in 12-1174, White Stallion Energy Center, LLC in 12-1194 [Service Date: 04/08/2013] Length of Brief: 937 Words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]--[Edited 04/11/2013 by AY] (Glaser, Peter)

04/08/2013
JOINT PETITIONER FINAL BRIEF [1429574] filed by American Public Power Association in 12-1173, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, Chase Power Development, LLC in 12-1191, Oak Grove Management Company, LLC in 12-1187, Kansas City Board of Public Utilities in 12-1186, Gulf Coast Lignite Coalition in 12-1188, Puerto Rico Electric Power Authority in 12-1189, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195 [Service Date: 04/08/2013] Length of Brief: 3,991 words. [12-1100,

12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Holmstead, Jeffrey)

04/08/2013
JOINT PETITIONER FINAL REPLY BRIEF [1429575] filed by American Public Power Association in 12-1173, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, Chase Power Development, LLC in 12-1191, Oak Grove Management Company, LLC in 12-1187, Kansas City Board of Public Utilities in 12-1186, Gulf Coast Lignite Coalition in 12-1188, Puerto Rico Electric Power Authority in 12-1189, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195 [Service Date: 04/08/2013] Length of Brief: 2,000 Words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Holmstead, Jeffrey)

04/08/2013
PETITIONER FINAL BRIEF [1429596] filed by Julander Energy Company in 12-1174 [Service Date: 04/08/2013] Length of Brief: 1496 words. [12-1100, 12-1174] (Bookbinder, David)

04/08/2013
PETITIONER FINAL REPLY BRIEF [1429599] filed by Julander Energy Company in 12-1174 [Service Date: 04/08/2013] Length of Brief: 750 words. [12-1100, 12-1174] (Bookbinder, David)

04/08/2013
PETITIONER FINAL REPLY BRIEF [1429602] filed by Sierra Club in 12-1194 [Service Date: 04/08/2013] [12-1194, 12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1195, 12-1196] (Narayan, Sanjay)

04/08/2013
JOINT INTERVENOR FOR RESPONDENT FINAL BRIEF [1429603] filed by Institute for Liberty, National Black Chamber of Commerce, National Mining Association, Peabody Energy Corporation, Sunflower Electric Power Corporation and Utility Air Regulatory Group in 12-1100, White Stallion Energy Center, LLC in 12-1194 [Service Date: 04/08/2013] Length of Brief: 3745. [12-1100, 12-1194] (Freeman, Lauren)

04/08/2013
SUPPLEMENT [1429612] to appendix [1428379-2] filed by Utility Air Regulatory Group in 12-1100 [Service Date: 04/08/2013] [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Freeman, Lauren)

04/08/2013
PETITIONER FINAL BRIEF [1429613] filed by Sierra Club in 12-1194 [Service Date: 04/08/2013] [12-1194, 12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1195, 12-1196] (Narayan, Sanjay)

04/08/2013
INTERVENOR FOR RESPONDENT FINAL BRIEF [1429622] filed by American Academy of Pediatrics, American Lung Association, American Nurses Association, American Public Health Association, Chesapeake Bay Foundation, Inc., Citizens for Pennsylvania's Future, Clean Air Council, Conservation Law Foundation, Environment America, Environmental Defense Fund, Izaak Walton League of America, NAACP, Natural Resources Council of Maine, Natural Resources Defense Council, Ohio Environmental Council, Physicians for Social Responsibility, Sierra Club and Waterkeeper Alliance in 12-1100 [Service Date: 04/08/2013] [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Narayan, Sanjay)

04/08/2013
JOINT PETITIONER FINAL BRIEF [1429635] filed by White Stallion Energy Center, LLC in 12-1100, National Mining Association in 12-1101, Institute for

Liberty and National Black Chamber of Commerce in 12-1102, Utility Air Regulatory Group in 12-1147, Midwest Ozone Group in 12-1172, American Public Power Association in 12-1173, Peabody Energy Corporation in 12-1175, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, United Mine Workers of America in 12-1183, Georgia Association of Manufacturers, Inc., Indiana Chamber of Commerce, Inc., Indiana Coal Council, Inc., Kentucky Chamber of Commerce, Inc., Kentucky Coal Association, Inc., North Carolina Chamber, Ohio Chamber of Commerce, Pennsylvania Coal Association, South Carolina Chamber of Commerce, The Virginia Chamber of Commerce, The Virginia Coal Association, Incorporated, West Virginia Chamber of Commerce, West Virginia Coal Association, Inc. and Wisconsin Industrial Energy Group, Inc. in 12-1182, State of Arkansas in 12-1190, Chase Power Development, LLC in 12-1191, Railroad Commission of Texas, State of Texas, Texas Commission on Environmental Quality and Texas Public Utility Commission in 12-1185, Edgecombe Genco, LLC and Spruance Genco, LLC in 12-1193, Kansas City Board of Public Utilities in 12-1186, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195, Terry E. Branstad, Commonwealth of Pennsylvania, Commonwealth of Virginia, John William Conway, State of Alabama, State of Alaska, State of Arizona, State of Florida, State of Idaho, State of Indiana, State of Kansas, State of Michigan, State of Mississippi, State of Missouri, State of Nebraska, State of North Dakota, State of Ohio, State of Oklahoma, State of South Carolina, State of Utah, State of West Virginia and State of Wyoming in 12-

1196 [Service Date: 04/08/2013] Length of Brief: 14,331 words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Brownell, F.)

04/08/2013

JOINT PETITIONER FINAL REPLY BRIEF [1429638] filed by White Stallion Energy Center, LLC in 12-1100, National Mining Association in 12-1101, Institute for Liberty and National Black Chamber of Commerce in 12-1102, Utility Air Regulatory Group in 12-1147, Midwest Ozone Group in 12-1172, American Public Power Association in 12-1173, Peabody Energy Corporation in 12-1175, Tri-State Generation and Transmission Association, Inc. in 12-1178, ARIPPA in 12-1181, United Mine Workers of America in 12-1183, Georgia Association of Manufacturers, Inc., Indiana Chamber of Commerce, Inc., Indiana Coal Council, Inc., Kentucky Chamber of Commerce, Inc., Kentucky Coal Association, Inc., North Carolina Chamber, Ohio Chamber of Commerce, Pennsylvania Coal Association, South Carolina Chamber of Commerce, The Virginia Chamber of Commerce, The Virginia Coal Association, Incorporated, West Virginia Chamber of Commerce, West Virginia Coal Association, Inc. and Wisconsin Industrial Energy Group, Inc. in 12-1182, State of Arkansas in 12-1190, Chase Power Development, LLC in 12-1191, Railroad Commission of Texas, State of Texas, Texas Commission on Environmental Quality and Texas Public Utility Commission in 12-1185, Edgecombe

Genco, LLC and Spruance Genco, LLC in 12-1193, Kansas City Board of Public Utilities in 12-1186, FirstEnergy Generation Corp. in 12-1192, Wolverine Power Supply Cooperative, Inc. in 12-1195, Terry E. Branstad, Commonwealth of Pennsylvania, Commonwealth of Virginia, John William Conway, State of Alabama, State of Alaska, State of Arizona, State of Florida, State of Idaho, State of Indiana, State of Kansas, State of Michigan, State of Mississippi, State of Missouri, State of Nebraska, State of North Dakota, State of Ohio, State of Oklahoma, State of South Carolina, State of Utah, State of West Virginia and State of Wyoming in 12-1196 [Service Date: 04/08/2013] Length of Brief: 7,224 words. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196] (Brownell, F.)

04/15/2013
PER ABOVE ORDER lodged appendix [1429356-2] is filed [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

04/17/2013
CORRECTED PETITIONER BRIEF [1431365] filed by Chesapeake Climate Action Network, Conservation Law Foundation, Environmental Integrity Project and Sierra Club in 12-1194 [Service

Date: 04/17/2013] [12-1194, 12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1195, 12-1196] (Narayan, Sanjay)

05/03/2013
MODIFIED EVENT--NOTICE FILED [1434314] filed by Railroad Commission of Texas, State of Texas, Texas Commission on Environmental Quality and Texas Public Utility Commission in 12-1185 to participate. [Service Date: 05/03/2013] [12-1185, 12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]--[Edited 05/07/2013 by LMF] (Walters, Mark)

05/03/2013
NOTICE FILED [1434328] filed by State of Alaska advising of their support of petitioner [Service Date: 05/03/2013] [12-1196] (Mulder, Steven)

12/10/2013
ORAL ARGUMENT HELD before Judges Garland, Rogers and Kavanaugh. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

01/06/2014
TRANSCRIPT [1473710] of oral argument [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

02/27/2014
PER ABOVE ORDER lodged letter Rule 28j authorities [1481306-2] is filed [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

04/15/2014
PER CURIAM JUDGMENT filed [1488343] that the petitions for review be denied except that the petition for review in No. 12-1174, Julander Energy Co. v. EPA, be dismissed for lack of standing for the reasons in the accompanying opinion . Before Judges: Garland, Rogers and Kavanaugh. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

04/15/2014
OPINION filed [1488346] PER CURIAM OPINION (Pages: 61), CONCURRING/DISSENTING OPINION (Pages: 29) by Judge Kavanaugh [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180,

12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

06/10/2014
MANDATE ISSUED to Environmental Protection Agency [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

07/16/2014
LETTER filed [1503809] by the Clerk of the Supreme Court of the United States notifying this court of the following activity in the case before it: A petition for writ of certiorari was filed and placed on the docket on 07/16/2014 as No. 14-46. [12-1196, 12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195]

07/16/2014
LETTER filed [1503810] by the Clerk of the Supreme Court of the United States notifying this court of the following activity in the case before it: A petition for writ of certiorari was filed and placed on the docket on 07/16/2014 as No. 14-47. [12-1147, 12-1100, 12-1101, 12-1102, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

07/16/2014
LETTER filed [1503811] by the Clerk of the Supreme Court of the United States notifying this court of the following activity in the case before it: A petition for writ of certiorari was filed and placed on the docket on 07/16/2014 as No. 14-49. [12-1101, 12-1100, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

11/25/2014
LETTER filed [1525142] by the Clerk of the Supreme Court of the United States notifying this court of the following activity in case No. 14-46: The petition for writ of certiorari was granted on 11/25/2014. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

11/25/2014
LETTER filed [1525143] by the Clerk of the Supreme Court of the United States notifying this court of the following activity in case No. 14-47: The petition for writ of certiorari was granted on 11/25/2014. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

11/25/2014
LETTER filed [1525144] by the Clerk of the Supreme Court of the United States notifying this court of the following activity in case No. 14-49: The petition for writ of certiorari was granted on 11/25/2014. [12-1100, 12-1101, 12-1102, 12-1147, 12-1172, 12-1173, 12-1174, 12-1175, 12-1176, 12-1177, 12-1178, 12-1180, 12-1181, 12-1182, 12-1183, 12-1184, 12-1185, 12-1186, 12-1187, 12-1188, 12-1189, 12-1190, 12-1191, 12-1192, 12-1193, 12-1194, 12-1195, 12-1196]

{U.S. EPA, Mercury Study Report to Congress, Vol. 1: Executive Summary, EPA-452/R-97-003 Docket No. EPA-HQ-OAR-2009-0234-3054 December 1997}
[Page 1]

OVERVIEW

This Mercury Study is a Report to Congress prepared by the U.S. Environmental Protection Agency. It fulfills the requirements of section 112(n)(1)(B) of the Clear Air Act, as amended in 1990. The Report provides an assessment of the magnitude of U.S. mercury emissions by source, the health and environmental implications of those emissions, and the availability and cost of control technologies. As the state-of-the-science for mercury is continuously and rapidly evolving, this Report should be viewed as a "snapshot" of our current understanding of mercury. This Report does not quantify the risk from mercury exposure because of scientific uncertainty in a number of important areas. The Report identifies areas where further research is needed to provide a quantitative risk assessment.

Mercury cycles in the environment as a result of natural and human (anthropogenic) activities. The amount of mercury mobilized and released into the biosphere has increased since the beginning of the industrial age. Most of the mercury in the atmosphere is elemental mercury vapor, which circulates in the atmosphere for up to a year, and hence can be widely dispersed and transported thousands of miles from likely sources of emission. Most of the mercury in water, soil, sediments, or

plants and animals is in the form of inorganic mercury salts and organic forms of mercury (e.g., methylmercury). The inorganic form of mercury, when either bound to airborne particles or in a gaseous form, is readily removed from the atmosphere by precipitation and is also dry deposited. Wet deposition is the primary mechanism for transporting mercury from the atmosphere to surface waters and land. Even after it deposits, mercury commonly is emitted back to the atmosphere either as a gas or associated with particles, to be re-deposited elsewhere. As it cycles between the atmosphere, land, and water, mercury undergoes a series of complex chemical and physical transformations, many of which are not completely understood.

Mercury accumulates most efficiently in the aquatic food web. Predatory organisms at the top of the food web generally have higher mercury concentrations. Nearly all of the mercury that accumulates in fish tissue is methylmercury. Inorganic mercury, which is less efficiently absorbed and more readily eliminated from the body than methylmercury, does not tend to bioaccumulate.

Mercury Emissions and Deposition in the U.S.

The best point estimate of annual anthropogenic U.S. emissions of mercury in 1994-1995 is 158 tons. Roughly 87 percent of these emissions are from combustion sources, including waste and fossil fuel combustion. Contemporary anthropogenic emissions are only one part of the mercury cycle. Releases from human activities today are adding to the mercury reservoirs that already exist in land, water, and air,

both naturally and as a result of previous human activities. The flux of mercury from the atmosphere to land or water at any one location is comprised of contributions from the natural global cycle including re-emissions from the oceans, regional sources, and local sources. Local sources could also include direct water discharges in addition to air emissions. Past uses of mercury, such as fungicide application to crops are also a component of the present mercury burden in the environment. One estimate of the total annual global input to the atmosphere from all sources including natural, anthropogenic, and oceanic emissions is 5,500 tons. Based on this, U.S. sources are estimated to have contributed about 3 percent of the 5,500 tons in 1995.

A computer simulation of long-range transport of mercury suggests that about one-third (~ 52 tons) of U.S. anthropogenic emissions are deposited, through wet and dry deposition, within the lower 48 States. The remaining two-thirds (~ 107 tons) is transported outside of U.S. borders where it diffuses into the global reservoir. In addition, the computer simulation suggests that another 35 tons of mercury from the global reservoir is deposited for a total deposition of roughly 87 tons. Although this type of

[Page O-2]
modeling is uncertain, the simulation suggests that about three times as much mercury is being added to the global reservoir from U.S. sources as is being deposited from it. What is not uncertain is that additional emissions to air will contribute to levels in the global reservoir, and concomitant deposition to water bodies.

The highest deposition rates from anthropogenic and global contributions for mercury are predicted to occur in the southern Great Lakes and Ohio River valley, the Northeast and scattered areas in the South, with the most elevated deposition in the Miami and Tampa areas. The location of sources, the chemical species of mercury emitted and the climate and meterology are key factors in mercury deposition. Humid locations have higher deposition than arid locations.

Public Health Impacts

Epidemics of mercury poisoning following high-dose exposures to methylmercury in Japan and Iraq demonstrated that neurotoxicity is the health effect of greatest concern when methylmercury exposure occurs to the developing fetus. Dietary methylmercury is almost completely absorbed into the blood and distributed to all tissues including the brain; it also readily passes through the placenta to the fetus and fetal brain. The reference dose (RfD) is an amount of methylmercury, which when ingested daily over a lifetime is anticipated to be without adverse health effects to humans, including sensitive subpopulations. At the RfD or below, exposures are expected to be safe. The risk following exposures above the RfD is uncertain, but risk increases as exposures to methylmercury increase.

Extrapolating from the high-dose exposures that occurred in the Iraq incident, the U.S. EPA derived a RfD for methylmercury of 0.1 µg/kg bw/day. While the U.S. EPA has been advised by scientific reviewers to employ this RfD for this analysis, new data are emerging. Currently ongoing are two large

epidemiology studies in the Seychelle Islands and in the Faroe Islands that were designed to evaluate childhood development and neurotoxicity in relation to fetal exposures to methylmercury in fish-consuming populations. Because of various limitations and uncertainties in all of the available data, the U.S. EPA and other Federal agencies intend to participate in an interagency review of the human data on methylmercury, including the most recent studies from the Seychelle Islands and the Faroe Islands. The purposes of this review are to refine the estimates of the level of exposure to mercury associated with subtle neurological endpoints and to further consensus between all of the Federal agencies. After this process, the U.S. EPA will determine if a change in the RfD for methylmercury is warranted.

Fish consumption dominates the pathway for human and wildlife exposure to methylmercury. This study supports a plausible link between anthropogenic releases of mercury from industrial and combustion sources in the United States and methylmercury in fish. However, these fish methylmercury concentrations also result from existing background concentrations of mercury (which may consist of mercury from natural sources, as well as mercury which has been re-emitted from the oceans or soils) and deposition from the global reservoir (which includes mercury emitted by other countries). Given the current scientific understanding of the environmental fate and transport of this element, it is not possible to quantify how much of the methylmercury in fish consumed by the U.S. population is contributed by

U.S. emissions relative to other sources of mercury (such as natural sources and re-emissions from the global pool). As a result, it cannot be assumed that a change in total mercury emissions will be linearly related to any resulting change in methylmercury in fish, nor over what time period these changes would occur. This is an area of ongoing study.

Critical elements in estimating methylmercury exposure and risk from fish consumption include the species of fish consumed, the concentrations of methylmercury in the fish, the quantity of fish consumed, and how frequently fish is consumed. The typical U.S. consumer eating fish from restaurants

[Page O-3]
and grocery stores is not in danger of consuming harmful levels of methylmercury from fish and is not advised to limit fish consumption. The levels of methylmercury found in the most frequently consumed commercial fish are low, especially compared to levels that might be found in some non-commercial fish from fresh water bodies that have been affected by mercury pollution. While most U.S. consumers need not be concerned about their exposure to methylmercury, some exposures may be of concern. Those who regularly and frequently consume large amounts of fish -- either marine species that typically have much higher levels of methylmercury than the rest of seafood, or freshwater fish that have been affected by mercury pollution -- are more highly exposed. Because the developing fetus may be the most sensitive to the effects from methylmercury, women of child-bearing age are regarded as the population of greatest

interest. In this Report, an analysis of dietary surveys led the U.S. EPA to conclude that between 1 and 3 percent of women of child-bearing age (i.e., between the ages of 15 and 44) eat sufficient amounts of fish to be at risk from methylmercury exposure, depending on the methylmercury concentrations in the fish. These consumers should be aware of the Food and Drug Administration and State fish advisories that suggest limiting the consumption of contaminated fish. Advisories in the United States have been issued by 39 states and some Tribes, warning against consumption of certain species of fish contaminated with methylmercury.

To the extent that concern is focused on high-end fish and seafood consumers, research is needed on the actual consumption patterns and estimated methylmercury exposure of this subpopulation. In addition, the findings from such research should be validated by analysis of hair samples from a representative sample of members of this subpopulation.

Environmental Impacts

The pattern of mercury deposition nationwide influences which eco-regions and eco-systems will be more highly exposed. Piscivorous (fish-eating) birds and mammals are more highly exposed to mercury than any other known component of aquatic ecosystems. Adverse effects of mercury on fish, birds and mammals include death, reduced reproductive success, impaired growth and development, and behavioral abnormalities.

Mercury contamination has been documented in the endangered Florida panther and the wood stork, as well as populations of loons, eagles, and furbearers such as mink and otter. These species are at high risk of mercury exposure and effects because they either are piscivores or eat piscivores. Concentrations of mercury in the tissues of wildlife species have been reported at levels associated with adverse health effects in laboratory studies with the same species. However, field data are insufficient to conclude whether piscivorous wading birds or mammals have suffered adverse effects due to airborne mercury emissions. Modeling analyses conducted for this Report suggest that it is probable that individuals of some highly exposed wildlife subpopulations are experiencing adverse effects due to airborne mercury emissions.

Mercury Control Technologies

Mercury is widely used in industry because of its diverse properties and serves as a process or product ingredient in several industrial sectors, however, industrial demand for mercury has declined by about 75 percent between 1988 and 1996, due largely to the elimination of mercury additives in paints and pesticides and the reduction of mercury in batteries. Most of the emissions of mercury are produced when waste or fuel containing mercury is burned. The U.S. EPA has already finalized emission limits for municipal waste combustors and medical waste incinerators. As a result, by the year 2000, emissions from these categories will decline at least 90 percent from 1995 levels. In addition, mercury emission

limits have been proposed for hazardous waste incinerators.

[Page O-4]

The largest remaining identified source of mercury emissions are coal-fired utility boilers. Although a number of mercury control technologies are being evaluated for utility boilers, most are still in the research stages, making it difficult to predict final cost-effectiveness as well as the time required to scale-up and commercialize the technologies. Because the chemical species of mercury emitted from boilers varies from plant to plant, there is no single control technology that removes all forms of mercury. There remains a wide variation in the end costs of control measures for utilities and the possible impact of such costs on utilities. Preliminary estimates of national control costs for utility boilers (based on pilot scale data) are in the billions of dollars per year. Ongoing research, as well as research needs related to mercury controls for utilities, are described in the document.

Cost-effective opportunities to deal with mercury during the product life-cycle, rather than just at the point of disposal, need to be pursued. A balanced strategy which integrates end-of-pipe control technologies with material substitution and separation, design-for-environment, and fundamental process change approaches is needed. In addition, international efforts to reduce mercury emissions as well as greenhouse gases will play an important role in reducing inputs to the global reservoir of mercury.

[Page 1-1]

1. THE MERCURY STUDY REPORT TO CONGRESS

The Clean Air Act Amendments of 1990 (CAA) established section 112(n)(1)(B) which requires the United States Environmental Protection Agency (U.S. EPA) to study the impacts of mercury air pollution. In particular, section 112(n)(1)(B) specifies the following:

> The Administrator shall conduct, and transmit to the Congress not later than 4 years after the date of enactment of the Clean Air Act Amendments of 1990, a study of mercury emissions from electric utility steam generating units, municipal waste combustion units, and other sources, including area sources. Such study shall consider the rate and mass of such emissions, the health and environmental effects of such emissions, technologies which are available to control such emissions, and the costs of such technologies.

The U.S. EPA designed the Mercury Study to address many different (but linked) types of information:

- data on type, sources, and trends in emissions;
- evaluation of the atmospheric transport of mercury to locations distant from emission sources;

- assessment of potential impacts of mercury emissions close to the source;
- identification of major pathways of exposure to humans and non-human biota;
- identification of the types of human health consequences of mercury exposure and the amount of exposure likely to result in adverse effects;
- evaluation of mercury exposure consequences for ecosystems and for non-human species;
- identification of populations especially at risk from mercury exposure due to innate sensitivity or high exposure; and
- estimates of control technology efficiencies and costs.

The Report used the above types of information to assess the impact of emissions to air of mercury from a variety of sources. This assessment included judgments as to the potential hazard to humans and wildlife of methylmercury exposure which (as is described in succeeding sections) is largely through the consumption of contaminated fish.

There was no attempt in this Report to do a comparative risk/benefit analysis of fish as an important source of protein and calories in the diet of U.S. populations. Such an analysis would be beyond the scope of the CAA mandate. As emphasized in succeeding sections, the typical U.S. consumer of fish is not in danger of consuming harmful levels of

methylmercury and is not being advised to reduce fish consumption.

[Page 1-2]

This Mercury Study Report to Congress fulfills the mandate of section 112(n)(1)(B). The Report is in eight volumes:

- Volume I: Executive Summary
- Volume II: An Inventory of Anthropogenic Mercury Emissions in the United States
- Volume III: Fate and Transport of Mercury in the Environment
- Volume IV: An Assessment of Exposure to Mercury in the United States
- Volume V: Health Effects of Mercury and Mercury Compounds
- Volume VI: An Ecological Assessment for Anthropogenic Mercury Emissions in the United States
- Volume VII: Characterization of Human Health and Wildlife Risks from Mercury Exposure in the United States
- Volume VIII: An Evaluation of Mercury Control Technologies and Costs.

The various analyses documented in this Report were designed and conducted in accordance with accepted guidelines and procedures. For example, the human health risk assessment performed for this

Report follows published Guidelines for Risk Assessment (including guidelines on *Exposure Assessment, Developmental Toxicity, Carcinogenicity* and *Germ Cell Mutagenicity*) and uses established methodologies for quantitative assessment of general systemic toxicity (e.g., in the calculation of reference doses (RfDs) and reference concentrations (RfCs)). Moreover, the assessment of ecological effects, presented in Volume VI, follows U.S. EPA's *Framework for Ecological Risk Assessment*. Criteria values for protection of piscivorous wildlife were developed using the methodology developed for the *Great Lakes Water Quality Initiative*.

In 1994, the National Research Council of the National Academy of Sciences, in *Science and Judgment in Risk Assessment*, recommended several areas in which U.S. EPA could improve its risk assessment and risk characterization practices. These recommendations are listed below along with a description of how they were implemented in this Report.

- *Provide an understanding of the type and magnitude of an adverse effect that a specific chemical or emission could cause under particular circumstances.* The Report characterizes both the type and magnitude of health and ecological effects associated with airborne emissions of mercury from anthropogenic sources.

- *Validate methods and models.* All models used for the Report were critiqued by scientific experts and model predictions were

compared to measured mercury levels using the most appropriate data available.

- *Describe the basis for default options.* All assumptions are described and justified based on available data. Where appropriate, exposure models were modified to improve assumptions and to focus on areas of prediction where use of model assumptions is most justified.

- *Articulate and prioritize data needs.* The Report includes a section on Research Needs in each volume.

- *Distinguish between variability and uncertainty.* The Report provides discussions that attempt to make these distinctions for the risk results.

[Page 1-3]

- *Perform formal uncertainty analyses.* Uncertainty analyses were formally conducted for the dose-response and exposure assessment steps of the study, and were implicit in weight-of-evidence processes used in the hazard identification step of the human health risk assessment and the problem formulation phase of the ecological risk assessment. Uncertainty also was analyzed quantitatively in other components of the study, such as in the calculation of bioaccumulation factors and the RfD for methylmercury.

4. MANAGEMENT ALTERNATIVES

Possible Control Strategies

Effective control of mercury emissions may require a mix of strategies. The four major types of control techniques reviewed include:

- Pollution prevention measures, including product substitution, process modification and materials separation;
- Coal cleaning;
- Alternative approaches; and
- Flue gas treatment technologies.

Table 4-1 summarizes mercury control techniques for selected source categories. Pollution prevention may be suitable for those processes or industries where a mercury substitute is demonstrated and available (e.g., mercury cell chlor-alkali plants). Another pollution prevention measure is material separation, which may be an appropriate approach for processes where mercury-containing products are disposed of by incineration, or where mercury can be reduced in the fuel prior to the fuel being combusted (e.g., medical waste incineration). Conventional regulatory strategies may be applicable when mercury is emitted to the environment as a result of trace contamination in fossil fuel or other essential feedstock in an industrial process (e.g., cement manufacturing). Other non-traditional approaches such as emissions trading or other market-based approaches may also prove feasible for mercury

control. In addition, emissions control is only one possible means for reducing human exposure. For example, the issuance of fish advisories (or increased public education about advisories already in place) is an alternative that would need to be explored when selecting among strategies for reducing risks to human health (though not to ecosystems).

Cost-effective opportunities to deal with mercury during the product life-cycle, rather than just at the point of disposal, need to be pursued. A balanced strategy which integrates end-of-pipe control technologies with material substitution and separation, design-for-environment, and fundamental process change approaches is needed. In addition, international efforts to reduce mercury emissions as well as greenhouse gases will play an important role in reducing inputs to the global reservoir of mercury.

As noted above, because of the current, limited scientific understanding of the environmental fate and transport of this pollutant, it is not possible to quantify the contribution of U.S. anthropogenic emissions relative to other sources of mercury, including natural sources and re-emissions from the global pool, on methylmercury levels in fish consumed by the U.S. population. Mercury methylation and subsequent uptake in fish is complex and not well understood. As a result, it cannot be assumed that a change in total mercury emissions will be linearly related to any resulting change in methylmercury in fish, nor over what time period these changes would occur. This is an area of ongoing study.

The analyses of control technologies and costs presented in this Report are not intended to replace a thorough regulatory analysis, as would be performed for a rulemaking. The information presented is

* * *

[Page 4-2]

Table 4-1
Summary of Mercury Control Techniques for Selected Source Types

Mercury Control Technique	Applicable Source Type	Estimated Mercury Removal Efficiency	Cross-Media Impacts?[a]	Other Pollutants Controlled	Comments
Product substitution (e.g., batteries, fluorescent lights)	MWCs, MWIs	Variable, depending on the extent of substitution	Yes	Could include other components of mercury-containing batteries, fluorescent lights and other products	Product substitution has reduced the use of mercury in household batteries Use of mercury-containing fluorescent lights has increased because of their energy efficiency, but lower mercury content is being achieved The impact of product substitution to other areas depends on specific circumstances, including technical and economic feasibility
Process modification	Mercury cell chlor- alkali plants	100%	Yes	None directly	In 1994, about one-half of the chlor-alkali plants used mercury-free processes Because the membrane cell process has lower electricity demands than the mercury cell process, plant conversion results in an energy savings Additional savings presumably also result by avoiding costs of recycling or disposing of mercuric wastes
Materials separation	MWCs and MWIs	Variable, depending on the extent of separation	Yes	Could include other components of mercury-containing wastes burned in MWCs or MWIs	Separation of low-volume materials containing high mercury concentrations (e.g., batteries, fluorescent lights, thermostats and other electrical items) can reduce mercury input to a combustor without removing energy content of the waste stream Household battery separation has been implemented by several communities; program efficiency ranges from 3 to 25 percent Material separation programs at hospitals have been successful

[Page 4-3]

Table 4-1 (continued)
Summary of Mercury Control Techniques for Selected Source Types

Mercury Control Technique	Applicable Source Type	Estimated Mercury Removal Efficiency	Cross-Media Impacts?[a]	Other Pollutants Controlled	Comments
Carbon filter beds	MWCs, utility boilers, industrial boilers	99%	Yes	Residual organic compounds, other heavy metals, SO_2, acid gases	Currently applied to five full-scale power plants in Germany, and planned to be installed on five hazardous waste incinerators in Europe Technically feasible to other sources, such as MWIs or smelters, but has not been applied Potential negative effects associated with the disposal of spent carbon and the potential for fires in the bed
Wet scrubbing	MWCs, MWIs, boilers	Can be >90% for water- soluble species; limited for elemental mercury	Yes	Acid gases, metals, particulate matter, dioxins, furans	Have not been applied to MWCs in the U.S., although they have been used at MWCs in Europe and MWIs in the U.S. 25 percent of coal-fired boilers currently have wet scrubbers Requires treatment of wastewater prior to disposal May form more toxic, lesser-chlorinated dioxin and furan congeners
Depleted brine scrubbing	Chlor-alkali plants	98%	Yes	None	Very little information is available on this technique
Treated activated carbon adsorption	Chlor-alkali plants	90%	Yes	Residual organic compounds, other heavy metals, SO_2, acid gases	Very little information is available on this technique In 1984, carbon bed systems were in use at 8 of the 20 chlor-alkali plants in operation in the U.S. at that time

[Page 4-4]

Table 4-1 (continued)
Summary of Mercury Control Techniques for Selected Source Types

Mercury Control Technique	Applicable Source Type	Estimated Mercury Removal Efficiency	Cross-Media Impacts?[a]	Other Pollutants Controlled	Comments
Selenium filters	Primary copper smelters, primary lead smelters, and (more limited) MWCs, crematories, power plants	90%	Yes	Particulate matter, acid gases	Factors that influence performance include inlet mercury concentrations, flue gas temperature and flue gas dust content Four known applications at smelters as well as a MWC and a crematory in Sweden; known installation at a German power plan; potentially applicable to MWIs Spent filter containing selenium and mercury must be landfilled after use More information needed on the possibility of selenium being emitted from the filter itself
Activated carbon injection	MWCs, MWIs, utility boilers	50-90+%	Yes	Chlorinated dioxins and furans, potentially other semi-volatile organics	Activated carbon injection efficiencies reported for utility boilers are based on pilot-scale data and as such have a high degree of uncertainty Factors that influence performance include flue gas temperature, amount of activated carbon injected, type of particulate matter collector, concentration and species of mercury in flue gas and type of carbon used Addition of carbon could have significant impact on amount of particulate matter requiring disposal from utility boilers, but not from MWCs or MWIs

[a] For the purpose of this table, cross-media impacts refer to the potential to transfer and release mercury to media other than air, such as soil, ground water, and surface water. For example, carbon filter beds and wet scrubbers remove mercury from air emissions but result in the generation and disposal of mercury-containing solid and liquid wastes, respectively. In the case of product substitution, cross-media impacts refer to the potential to decrease airborne emissions of mercury at one site but increase such emissions elsewhere.

[Page 4-5]
intended to present the range of available options and provide a relative sense of the extent of mercury reductions achievable and the general magnitude of the cost of such reductions.

Pollution Prevention Measures

One possible means of achieving reductions in mercury emissions is through the use of pollution prevention or source reduction. Such approaches to achieving reductions involve changes in processes or inputs to reduce or eliminate emissions of mercury from a particular product or process. They could include, for example, the replacement of mercury with an appropriate substitute or the use of lowmercury constituents.

In considering opportunities for pollution prevention or source reduction it is important to consider both the potential reductions achievable and the costs of these options. Any consideration of the potential reductions, should examine whether (and the extent to which) emission reductions from the particular sources in question will yield reductions in risk to public health and the environment. It is also essential to understand the costs associated with implementing a pollution prevention measure, including any changes in the quality of the end product.

Removing mercury-containing products such as batteries, fluorescent lights and thermostats from the waste stream can reduce the mercury input to waste combustors without lowering the energy content of the waste stream. The mercury removal

efficiency would vary, however, depending on the extent of the separation. Many materials in wastes contain mercury. Materials that comprise a large portion of the waste stream, such as paper, plastic, dirt and grit and yard waste, contain very low concentrations of mercury. Therefore, obtaining appreciable mercury reduction from separation of these types of materials would require separating a large fraction of the total waste stream. Separating these materials would counter the intended purpose of the combustion process, which is to disinfect and reduce the volume of waste materials.

Other materials contain higher concentrations of mercury, but make up only a very small portion (less than 1 percent)of the total waste stream. These materials include mercuric oxide batteries, fluorescent lights, thermostats and other electrical items. Separation of such materials can reduce mercury input to a combustor without removing any of the energy content of the waste stream. To evaluate a materials separation program, the feasibility and costs of separating a particular material should be compared with the mercury emission reduction achieved. Furthermore, the current and future mercury reduction achieved by separating a certain material should be considered since the mercury content of some items such as household batteries has already declined considerably.

Coal Cleaning

Coal cleaning is another option for removing mercury from the fuel prior to combustion. In some states, certain kinds of coal are commonly cleaned to

increase its quality and heating value. Approximately 77 percent of the eastern and midwestern bituminous coal shipments are cleaned in order to meet customer specifications for heating value, ash content and sulfur content. Any reduction in mercury content achieved by coal cleaning results in a direct decrease in mercury emissions from the boiler. The mercury removed by cleaning processes is transferred to coal-cleaning wastes, which are commonly in the form of slurries. No data are available to assess the emissions of mercury from coalcleaning slurries.

Volume II of this Report (An Inventory of Anthropogenic Mercury Emissions in the United States) presents available data on the mercury concentrations in raw coal, cleaned coal and the percent reduction achieved by cleaning. These data, which cover a number of different coal seams in four states (Illinois, Pennsylvania, Kentucky and Alabama), indicate that mercury reductions range from 0 to 64

[Page 4-6]
percent, with an overall average reduction of 21 percent. This variation may be explained by several factors, including different cleaning techniques, different mercury concentrations in the raw coal and different mercury analytical techniques. It is expected that significantly higher mercury reductions can be achieved with the application of emerging coal preparation processes. For example, in one benchscale study, five types of raw coal were washed by conventional cleaning methods followed by column froth floatation or selective agglomeration.

Conventional cleaning and column froth flotation reduced mercury concentrations from the raw coals by 40 to greater than 57 percent, with an average of 55 percent. Conventional cleaning and selective agglomeration reduced mercury concentrations from the raw coals by greater than 63 percent to 82 percent, with an average of 68 percent. In a second benchscale study in which three types of coals were cleaned with a heavy-media-cyclone (a conventional cleaning method) followed by a water-only-cyclone and a column froth flotation system, mercury concentrations in the raw coal were reduced by as much as 63 to 65 percent. Bench-scale testing is also being carried out by DOE to investigate the use of naturally occurring microbes to reduce mercury (and other trace elements) from coal.

Alternative Approaches

There are a variety of flexible approaches for reducing the emissions of hazardous air pollutants. These include incentive- or market-based systems, "co-control," and energy conservation and renewable energy initiatives.

Incentive-based systems are tools that provide industry with more flexibility than traditional regulatory programs. In such a system, the regulatory agency generally sets a ceiling on allowable emissions (a cap) for each source along with clear and certain penalties for missing the target, but regulated entities have complete choice in how these targets will be met. The cost to industry is determined by the market and by the innovation used in meeting the cap. Emissions cap programs allow for increased incentives because sources that

reduce emissions below their cap can sell the surplus reduction to sources that cannot achieve their cap. Trading is promising where sources have different compliance costs, or where local environmental impacts are minimal. Sources that reduce emissions before they are required to do so can "bank" the excess reductions and save them for later. Examples of existing market-based programs include the SO2 allowance trading and NO_x averaging programs implemented under Title IV of the CAA Amendments to reduce acid deposition; the Regional Clean Air Incentives Market Program and Rules developed in California to reduce emissions of NO_x, SOx, and reactive organic compounds; and U.S. EPA's Lead Trading Program designed to reduce the emissions of lead from gasoline in the mid-1980's.

Incentive-based systems to reduce mercury emissions, either through regulation or voluntary means, may be attractive to utilities and other facilities for several reasons: to reduce mercury emissions at a lower per unit cost, to insure against future regulation, to reduce the compliance costs of regulation, to bank credits toward future regulatory requirements, to build experience with technology and to demonstrate environmental leadership. Also, incentive-based programs could provide financing for the control of mercury among different industries (and potentially other countries) and may be a viable option for utilities and other sources where cost-effective technologies have yet to be identified.

Co-control refers to the control of mercury by control devices or other management measures that were designed or prescribed to limit the emissions of

pollutants other than mercury. Co-control can also be achieved through the implementation of the National Ambient Air Quality Standards (NAAQS) for ozone and particulate matter (PM). In support of the revised ozone and PM NAAQS, the U.S. EPA conducted numerous detailed analyses to predict what control approaches industry might use to achieve the new standards. Fuel switching, in which one fuel is switched to another (e.g., high-sulfur coal to lowsulfur coal, or coal to natural gas) to achieve emissions reductions, is also an alternative to direct control.

[Page 4-7]

U.S. EPA estimates that implementation of the New Fine Particle Standard for ambient air quality through a regional control strategy that significantly reduces SOx below the CAA's Title IV requirements can indirectly lower forecasted mercury emissions in 2010 by about 11 tons from electric power generation by units burning fossil fuels. This reduction occurs from both the additions of flue gas desulfurization units (scrubbers) at coal-fired boilers to lower SOx emissions and through greater reliance by the power industry on producing electricity from natural gas as another way to reduce SOx. In the Regulatory Impact Analysis for the new NAAQS, U.S. EPA estimated that in 2010 a regional SOx reduction strategy for the electric power industry to lower fine particle formation will lead to the installation of scrubbers on additional 60 GWs of coal-fired capacity (increasing forecasted scrubber capacity under Title IV by about two-thirds). U.S. EPA assumes that scrubbers remove close to 30 percent of the mercury contained in coal flue gas. U.S. EPA also estimated

that electricity produced from natural gas would increase by 16 percent above baseline levels. Natural gas combustion produces negligible levels of mercury emissions.

Title IV of the CAA also encourages energy conservation measures and use of renewable energy as a long-term strategy for reducing air pollution and other adverse effects of energy production and use. Renewable energy is defined as energy that is derived from biomass, solar, geothermal or wind.

Flue Gas Treatment Technologies

Most metals have sufficiently low vapor pressures at typical air pollution control device operating temperatures that condensation onto particulate matter is possible. Mercury, on the other hand, has a high vapor pressure at typical control device operating temperatures, and collection by particulate matter control devices is highly variable.

In Volume VIII of this Report (An Evaluation of Mercury Control Technologies and Costs), add-on controls to reduce mercury emissions are described in detail including information on commercial status, performance, applicability to the specified mercury emission sources, and secondary impacts and benefits. The controls described are:

- Carbon filter beds;
- Wet scrubbing for waste combustors and utility boilers;
- Depleted brine scrubbing;

- Treated activated carbon adsorption;
- Selenium filters; and
- Activated carbon injection.

The most important conclusions from the assessment of flue gas treatment technologies include:

- Factors that enhance mercury control are low temperature in the control device system (less than 150 °Celsius [°C] [300 to 400 °Fahrenheit (°F)]), the presence of an effective mercury sorbent and a method to collect the sorbent. In general, high levels of carbon in the fly ash enhance mercury sorption onto particulate matter which is subsequently removed by the particulate matter control device. Additionally, the presence of hydrogen chloride (HCl) in the flue gas stream can result in the formation of mercuric chloride ($HgCl_2$), which is readily adsorbed onto carbon-containing particulate matter, or can be efficiently scrubbed by a wet FGD system. Conversely, sulfur dioxide (SO_2) in flue gas can act as a reducing agent to convert oxidized mercury to elemental mercury, which is more difficult to collect.

- Conversion of mercury cell chlor-alkali plants to a mercury-free process is technically feasible and has been previously demonstrated.

[Page 4-8]

- Control technologies designed for control of pollutants other than mercury (e.g., acid gases

and particulate matter) vary in their mercury-removal capability, but in general achieve reductions no greater than 50 percent (except for high removal efficiencies for $HgCl_2$ by wet scrubbers).

- Selenium filters are a demonstrated technology in Sweden for control of mercury emissions from lead smelters. Carbon filter beds have been used successfully in Germany for mercury control on utility boilers and MWC's. These technologies have not been demonstrated in the U.S. for any of these source types.

- Injection of activated carbon into the flue gas of MWC's and MWI's can achieve mercury reductions of at least 85 percent. The addition of activated carbon to the flue gas of these source types would not have a significant impact on the amount of particulate matter requiring disposal.

- No full-scale demonstrations of activated carbon injection for utility boilers have been conducted in the U.S. Based on limited pilot-scale testing, activated carbon injection provides variable control of mercury for utility boilers (e.g., the same technology might capture 20 percent of the mercury at one plant and 80 percent at another). The most important factors affecting mercury control on utility boilers include the flue gas volume, flue gas temperature and chloride content, the mercury concentration and chemical form of mercury being emitted.

- The chemical species of mercury emitted from utility boilers vary significantly from one plant to

another. Removal effectiveness depends on the species of mercury present. To date, no single control technology has been identified that removes all forms of mercury.

- The addition of activated carbon to utility flue gas for mercury control would significantly increase the amount of particulate matter requiring disposal.

Cost of Controls

The overall approach for assessing the cost of "end-of-pipe" flue gas treatment technologies was to select a subset of source categories on the basis of either their source category emissions in the aggregate or their potential to be significant point sources of emissions. Consideration was also given to whether a particular source category was a feasible candidate for application of a control technologybased standard under section 112 of the CAA. The cost analyses cover four source categories: municipal waste combustors (MWC), medical waste incinerators (MWI), chlor-alkali plants, and utility boilers.

In addition to determining the cost effectiveness of applying mercury control technology, a financial analysis was performed to evaluate the affordability of mercury control (in terms of potential price increases or impacts on financial impact) for the selected source categories.

[Page 4-9] **Table 4-2**
Potential Mercury Emission Reductions and Costs for Selected Source Categories

Mercury Source Category	Number of Facilities	% of U.S. Mercury Emission Inventory	Mercury Control Techniques	Potential National Reductions[a]	Potential National Annual Costs[b]	Cost-Effectiveness ($/lb of mercury removed)[c]
Municipal waste combustors	129	18.7	Material separation Product substitution Activated carbon injection Carbon filter beds Polishing wet scrubber	26 tons (90% reduction) By 2000, based on final emissions guidelines	$11.4-47 million	$211-870
Medical waste incinerators	~2,400	10.1	Material separation Wet scrubber or dry scrubber with carbon Activated carbon injection	15 tons (95% reduction) By 2000, based on final emissions guidelines	$60-120 million[d]	$2,000-$4,000[d]
Coal-fired utility boilers	426 (1,043 boilers)	32.6	Fuel switching Advanced coal cleaning Activated carbon injection Carbon filter beds	37 tons (90% reductions) [e]	$5 billion	$67,700-70,000
			Co-control: ozone and PM NAAQS	11 tons[f]	No incremental mercury control	No incremental mercury control costs
Chlor-alkali plants using the mercury cell	14	4.5	Process modification Depleted brine scrubbing Treated activated carbon adsorption	7.1 tons (100% reduction)	$65 million	$4,590
Total	~3,600	65.9			~$5.2 billion	

NOTE: The underlined mercury control techniques are the techniques on which potential national reductions and potential national annual costs are based.

[a] Estimated reductions assuming every facility could achieve the reduction listed.
[b] Potential national costs are estimates only and assume all facilities would incur the same costs as the model plants used in the analysis.
[c] Where cost-effectiveness values are presented as a range, the values reflect the range across facilities of different sizes.
[d] Cost of control should not be attributed to mercury control alone. Wet scrubbers efficiently remove nine other pollutants from the MWI flue gas as required by the emission guidelines for MWIs.

[e] The potential national reductions reflects sufficient amounts of activated carbon to control mercury emissions from coal-fired utility boilers by 90 percent. Activated carbon injection has not been demonstrated for a full-scale utility boiler application. Control costs are upper bound based on high temperature activated carbon injection. The 37 tons reduction is 90 percent of 41 tons, accounting for the 11 ton reduction from the ozone and PM NAAQS.

[f] Assumes some fuel switching and additional installation of wet scrubbers which are asumed to remove 30 percent.

Table 4-2 presents the four source categories for which a control technology and cost analysis was performed. The selection of a particular type of control for the cost analysis should not be construed to mean that the U.S. EPA has selected, or has preference for, this technology for a given source category. The table presents the number of facilities in each category and the percent contribution of each to the national inventory. Potential national mercury reductions, potential national control costs and cost-effectiveness estimates are also presented. These estimates are based on the assumption that all plants within a source category will achieve the same reductions and incur the same costs as the model plants used in the analysis. Because this assumption would not be applicable in all circumstances, the estimates of potential reductions and costs should be used only for relative comparisons among the source categories to give an initial indication as to where mercury controls could provide the most emission reduction for the least cost.

The cost of mercury control incurred by any specific facility may be underestimated by the cost analysis presented in this Report because of variability inherent in the assumptions that were made in the analyses. These assumptions include the efficiency of the various control techniques for reducing mercury, the amount of mercury in the flue gas stream and other site-specific factors such as down-time and labor costs. In addition, costs for monitoring and recordkeeping were not included in the cost analyses. These requirements would be specific to a regulatory action. On the other hand, the costs represent retrofit application of controls.

Installation of controls at new facilities can be significantly less expensive than retrofitting an existing facility.

The estimates of cost for mercury reductions also do not illustrate two important considerations. One is that, as presented, all of the cost of control could mistakenly be attributed to mercury removal. As described previously in this Report, many of these controls achieve reductions of other pollutants as well (e.g., acid gases, dioxin, other metals). In some cases (e.g., the emission guidelines for MWI), the choice of control technology or control strategy is aimed at reducing pollutants other than mercury. In these cases, there is a co-control benefit of mercury reduction. The benefits of reducing other pollutants should be considered when interpreting the mercury control costs. Second, the technologies available for mercury control represent relatively new applications of these technologies. Thus, in the future, it is likely that as new or emerging technologies develop, the cost-effectiveness of control will improve. Air pollution control and prevention techniques are continuously under development and improvement. There is a fairly rapid pace of innovation in the air pollution control sector. The demand for cleaner products and cleaner processes that lower overall costs, combined with the necessity for improved air and water quality, create strong incentives for technological innovation and a growing market for such innovations. As the demand for more innovative, cost-effective and cost-saving technologies increase, new technologies will move from the research and development or pilot program phase to commercial availability.

While existing technology will play a key role in reducing mercury from some sources, emerging technology may be more appropriate for others. Innovations in environmental policies may also play a key role in developing a national management strategy for mercury. These innovations could include multi-media approaches, greater emphasis on pollution prevention, regional control strategies and optimization of co-control opportunities.

[* * *]

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Research Triangle Park, NC 27711

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Air

EPA

Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress

Volume 1.

[Page ES-1]

EXECUTIVE SUMMARY

ES.1 LEGISLATIVE MANDATE

In section 112(n)(1)(A) of the Clean Air Act, as amended (the Act), Congress directs the United States Environmental Protection Agency (EPA) to:

> "... perform a study of the hazards to public health reasonably anticipated to occur as a result of emissions by electric utility steam generating units of ... [hazardous air

> pollutants] ... after imposition of the requirements of this Act."

Section 112(a)(8) of the Act defines an "electric utility steam-generating unit" as "any fossil-fuel–fired combustion unit of more than 25 megawatts electric (MWe) that serves a generator that produces electricity for sale." A unit that cogenerates steam and electricity and supplies more than one-third of its potential electric output capacity and more than 25 MWe output to any utility power distribution system for sale is also considered an electric utility steam-generating unit (i.e., utility unit).

Section 112(n)(1)(A) also requires that:

- The EPA develop and describe alternative control strategies for hazardous air pollutants (HAPs) that may warrant regulation under section 112; and

- The EPA proceed with rulemaking activities under section 112 to control HAP emissions from utilities if EPA finds such regulation is appropriate and necessary after considering the results of the study.

ES.2 REGULATORY DETERMINATION

This report does not contain a determination as to whether or not regulations to control HAP emissions from utility units are appropriate and necessary. The Agency has deferred the regulatory determination until a later date.

ES.3 OVERVIEW APPROACH TO COMPLETING THE STUDY

The study included numerous separate and interrelated analyses. First, HAP emissions test data were gathered from 52 utility units (i.e., boilers), including a range of coal-, oil-, and natural gas-fired utility units. Second, the emissions test data along with facility specific information (e.g., boiler type, control device, fuel usage) were used to estimate HAP emissions from all 684 utility plants in the United States (U.S.). Third, a screening level hazard/risk assessment was completed to prioritize the HAPs for further analyses. Fourth, various priority HAPs were analyzed for inhalation and

[Page ES-2]
multipathway exposures and risks and other potential impacts. In addition, potential control strategies were analyzed for the priority HAPs. The overall summary of the study is presented in Figure ES-1.

This report presents the findings of the study. The primary components of this report are: (1) a description of the industry; (2) an analysis of emissions data; (3) an assessment of hazards and risks due to inhalation exposures to 67 HAPs; (4) assessments of risks due to multipathway (inhalation plus non-inhalation) exposures to four HAPs (radionuclides, mercury, arsenic, and dioxins); and (5) a discussion of alternative control strategies.

The study was based primarily on two scenarios: (1) 1990 base year emissions; and (2) 2010 emissions. In addition, emissions for 1994 were estimated using

the most recent data. The 1990 scenario was chosen since that was the year the Amendments to the Act were passed and was the latest year for which utility operational data were available at the time the study was initiated. The 2010 scenario was selected to meet the section 112(n)(1)(A) mandate to evaluate hazards "after imposition of the requirements of the Act." Primarily, this meant assessing the hazards after the acid rain program is in place. The 2010 scenario also included estimated changes in HAP emissions resulting from projected trends in fuel choices and projected increases in electric power demands. However, the effects of other on-going or potential activities that were not factored into the 2010 projections (e.g., industry restructuring, new ozone and particulate matter [PM] standards, global climate change programs) may result in the 2010 projections being either underestimated or overestimated.

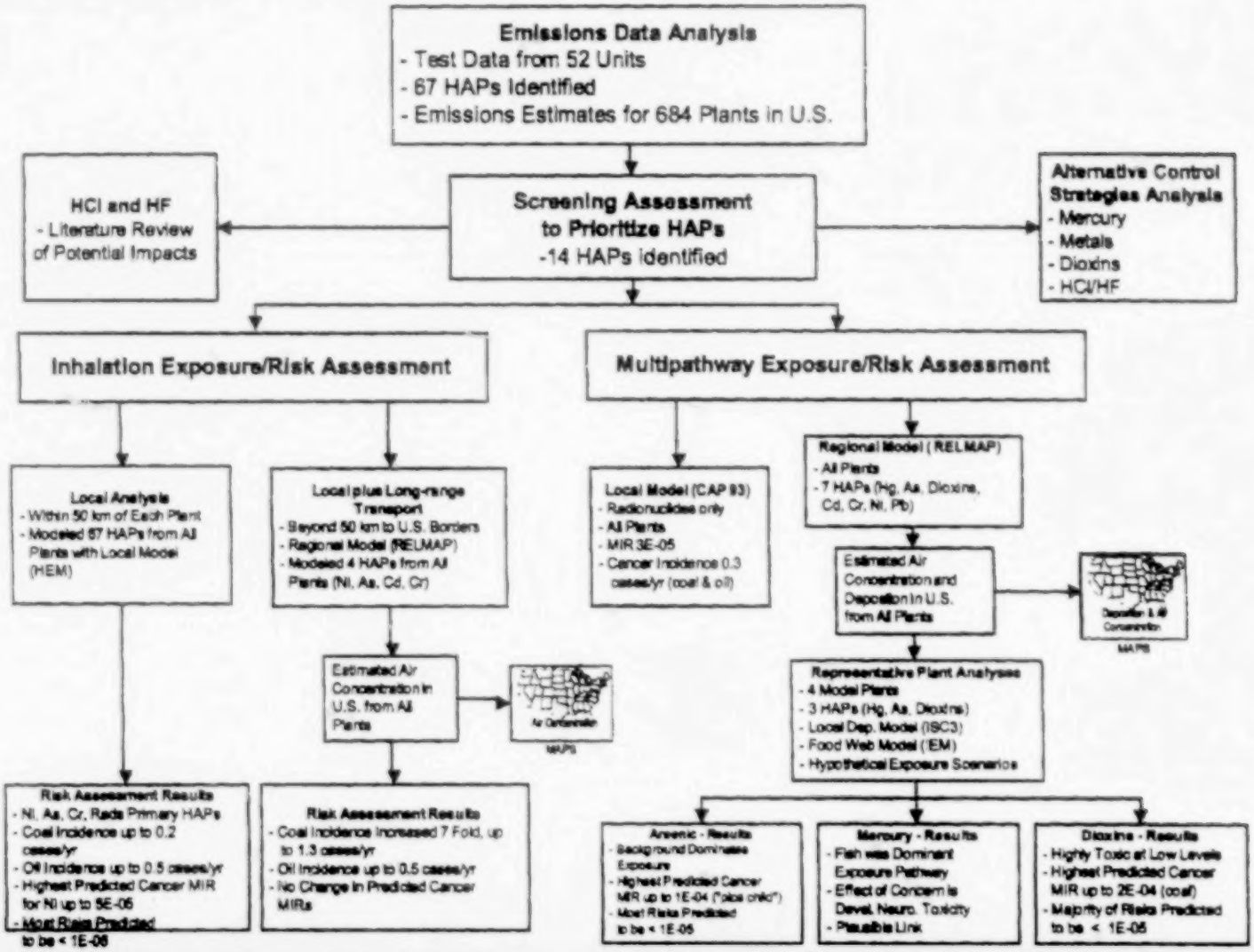
ES.4 EMISSIONS DATA ANALYSIS

A total of 684 utility plants (i.e., utilities) were identified as meeting the criteria for the study in 1990 in the U.S. These utilities are fueled primarily by coal (59 percent of total units), oil (12 percent), or natural gas (29 percent). Many plants have two or more units and several plants burn more than one type of fuel (e.g., contain both coal- and oil-fired units). In 1990, there were 426 plants that burned coal as one of their fuels, 137 plants that burned oil, and 267 plants that burned natural gas.

Emission estimates for the years 1990, 1994, and 2010 were based on emissions test data from 52 units obtained from extensive emission tests by the

Electric Power Research Institute (EPRI), the Department of Energy (DOE), the Northern States Power Company, and the EPA. The testing program was designed to test a wide range of facility types with a variety of control scenarios; therefore, the data are considered generally representative of the industry. However, there are uncertainties in the data because of the small sample sizes for specific boiler types and control scenarios.

[Page ES-3] **Figure ES-1. Overall Structure of Utility Air Toxics Study Analyses**



[Page ES-4]

These test data provided the basis for estimating average annual emissions for each of the 684 plants. A total of 67 of the 188 HAPs listed in section 112 of the Act were identified in the emissions testing program as potentially being emitted by utilities. Tables ES-1 and ES-2 present estimated emissions for, respectively, a subset of priority HAPs for 1990, 1994, and 2010, and for a set of characteristic boilers for 1994.

Although the EPA used average annual emissions estimates in assessing long-term exposures to individual HAPs on a national basis, emissions test data were not available for each utility in the U.S. Therefore, estimates for individual plants are particularly uncertain. Based on an uncertainty analysis, the average annual emissions estimates are expected to be roughly within a factor of plus or minus three of actual annual emissions. However, even this uncertainty analysis had limitations. For example, the uncertainty analysis did not include data on potential upsets or unusual operating conditions; therefore, the range of uncertainty could be greater.

ES.5 GENERAL APPROACH TO EXPOSURE AND RISK ASSESSMENT

Most of the risk assessment focused on inhalation exposure. All 67 HAPs were assessed for inhalation exposures, at least at a screening level. For many of the 67 HAPs, inhalation exposure is believed to be the dominant exposure pathway. However, for HAPs that are persistent and/or bioaccumulate, and are toxic by ingestion (or are

radioactive), the non-inhalation exposure pathways could be more important. Based on a screening and prioritization assessment, which is described below, the EPA identified four high priority HAPs (radionuclides, mercury, arsenic, dioxins) to assess for noninhalation exposures. In addition, cadmium and lead were identified as next highest priority. Multipathway assessments are presented for radionuclides, mercury, arsenic, and dioxins. The other two HAPs (lead and cadmium) were examined qualitatively for their potential for multipathway hazards.

ES.6 SCREENING ASSESSMENT

As outlined in Figure ES-1, EPA initially conducted a screening assessment that considered inhalation and non-inhalation exposure routes for all 67 HAPs to identify priority HAPs for more detailed assessment. To screen for inhalation exposures, the EPA used the Human Exposure Model (HEM) to model the 67 HAPs from all 684 utility plants utilizing generally conservative assumptions (i.e., assumptions that are more likely to overestimate rather than underestimate risks) to estimate inhalation risks for maximally exposed individuals (MEIs).

[Page ES-5]

Table ES-1. Nationwide Utility Emissions for Thirteen Priority HAPs[a]

HAP	Nationwide HAP emission estimates (tons per year)[b]								
	Coal			Oil			Natural gas		
	1990	1994	2010	1990	1994	2010	1990	1994	2010
Arsenic	61	56	71	5	4	3	0.15	0.18	0.25
Beryllium	7.1	7.9	8.2	0.46	0.4	0.23	NM[c]	NM	NM
Cadmium	3.3	3.2	3.8	1.7	1.1	0.9	-	-	-
Chromium	73	62	87	4.7	3.9	2.4	-	-	-
Lead	75	62	87	11	8.9	5.4	0.43	0.47	0.68
Manganese	164	168	219	9.3	7.3	4.7	-	-	-
Mercury	46	51	60	0.25	0.2	0.13	0.0015	0.0017	0.024
Nickel	58	52	69	390	320	200	2.2	2.4	3.5
Hydrogen chloride	143,000	134,000	155,000	2,900	2,100	1,500	NM	NM	NM
Hydrogen fluoride	20,000	23,000	26,000	140	280	73	NM	NM	NM
Acrolein	25	27	34	NM	NM	NM	NM	NM	NM
Dioxins[d]	0.000097	0.00012	0.00020	1×10^{-5}	9×10^{-6}	3×10^{-6}	NM	NM	NM
Formaldehyde	35	29	45	19	9.3	9.5	36	39	57

[a] Radionuclides are the one priority HAP not included on this table because radionuclide emissions are measured in different units (i.e., curies per year) and, therefore, would not provide a relevant comparison to the other HAPs shown. Radionuclide emissions are presented in chapter 9.

[b] The emissions estimates in this table are derived from model projections based on a limited sample of specific boiler types and control scenarios. Therefore, there are uncertainties in these numbers (see section ES.4 for discussion).

[c] NM = Not measured.

[d] These emissions estimates were calculated using the toxic equivalency (TEQ) approach, which is based on the summation of the emissions of each congener after adjusting for toxicity relative to 2,3,7,8-tetrachlorodibenzo-p-dioxin (i.e., 2,3,7,8-TCDD).

[Page ES-6]

Table ES-2. Estimated Emissions for Nine Priority HAPs from Characteristic Utility Units (1994; tons per year)[a]

Fuel:	Coal	Oil	Natural gas
Unit size (MWe):	**325**	**160**	**240**
Arsenic	0.0050	0.0062	0.0003
Cadmium	0.0023	0.0014	NC[b]
Chromium	0.11	0.0062	NC
Lead	0.021	0.014	NC
Mercury	0.05	0.0012	NC
Hydrogen chloride	190	9.4	NC
Hydrogen fluoride	14	NC	NC
Dioxins[c]	0.00000013	0.000000023	NC
Nickel	NC	1.7	0.004

[a] There are uncertainties in these numbers. Based on an uncertainty analysis, the EPA predicts that the emissions estimates are generally within a factor of roughly three of actual emissions.

[b] NC = Not calculated.

[c] See footnote d of Table ES-1.

If the MEI risk was above a minimum measure (e.g., exposure greater than one-tenth the inhalation reference concentration [RfC][a] or cancer risk greater than 1 chance in 10 million), then the HAP was chosen for more study. For non-inhalation exposures, the 67 HAPs were prioritized by considering five criteria: (1) persistence; (2) tendency to bioaccumulate; (3) toxicity; (4) emissions quantity; and (5) radioactivity.

Based on this screening assessment, a total of 14 HAPs were identified as priority. Twelve HAPs (arsenic, beryllium, cadmium, chromium, manganese, nickel, hydrogen chloride [HCl], hydrogen fluoride [HF], acrolein, dioxins, formaldehyde, and radionuclides) were identified as priority pollutants for further study based on potential for inhalation exposures and risks. Four of these 12 HAPs (arsenic, cadmium, dioxins, and radionuclides) plus 2 additional HAPs (mercury and lead) were considered priority for multipathway exposure); of these 6 HAPs, 4 (arsenic, mercury, dioxins, and radionuclides) were identified as the highest priority to assess for

[Page ES-7]
multipathway exposures and risks. Overall, a total of 14 of the 67 HAPs were considered priority. The other 53 HAPs were not evaluated beyond the screening assessment.

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[a] The RfC is an estimate (with uncertainty spanning perhaps an order of magnitude) of the daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious effects during a lifetime.

ES.7 INHALATION RISK ASSESSMENT -- LOCAL ANALYSIS

The EPA estimated inhalation exposures and risks due to dispersion of HAP emissions within 50 kilometers (km) of each of the 684 plants (i.e., local analysis). For 13 of the 14 priority HAPs, the HEM was used; for radionuclides, the Clean Air Act Assessment Package-1993 (CAP-93) model was used. The HEM exposure modeling conducted for the inhalation risk assessment was very similar to the modeling conducted for the screening assessment. The same default options and same input data were used. However, there is one important difference. For the inhalation risk assessment, a distinction was made between urban and rural locations. If a plant is located in an urban area, it was modeled using the urban mode (i.e., dispersion is assumed to be characteristic of emissions emitted by a facility in an urban location where there are buildings nearby). Dispersion of the pollutant plume in an urban area is expected to exhibit greater turbulence because of heat transfer and obstacles (i.e., large buildings). If a plant is located in a rural location, it was modeled using the rural mode (i.e., dispersion is assumed to be characteristic of a facility located in a rural location). In the screening assessment, all plants were modeled using the urban default because using the urban default typically leads to more conservative (i.e., higher) estimates of human exposures, which is appropriate for a screening assessment. However, using the urban and rural distinction is believed to reflect more realistic conditions.

The cancer risks for all gas-fired plants were well below one chance in one million (i.e., $< 1 \times 10^{-6}$) and no noncancer hazards were identified. Therefore, gas-fired plants are omitted from the following discussions.

In cases where data were missing or incomplete, the EPA had to make various assumptions. A few of these assumptions are more likely to overestimate risks. Other assumptions used are likely to underestimate risks. Based on an uncertainty analysis conducted for this study, it is estimated that these assumptions taken together lead to a reasonable high-end estimate (i.e., conservative, but within the bounds of reasonable estimates) of the risks due to inhalation exposure within 50 km of plants. Within the limits of current scientific information, this approach is, therefore, most likely to overestimate health risks for these pollutants. The uncertainty analysis suggests that the most likely estimated inhalation MIRs (i.e., central tendency MIRs) may be roughly 2 to 10 times lower than the high-end MIRs presented below. The average individual risks due to inhalation exposure to utility HAP emissions for the total exposed U.S. population (roughly 200,000,000 people) are predicted to be roughly 100 to 1000 times lower than the high-end inhalation MIRs.

[Page ES-8]

ES.7.1 Inhalation Cancer Risks for Coal-Fired Utilities Based on Local Analysis (1990)

The vast majority of coal-fired plants (424 of the 426 plants) are estimated to pose lifetime cancer risks (i.e., increased probability of an exposed person

getting cancer during a lifetime) of less than 1 x 10^{-6} due to inhalation exposure to utility HAP emissions. Only two of the 426 plants are estimated to potentially pose inhalation risks greater than 1 x 10^{-6} (see Figure ES-2).

The increased lifetime cancer MIR due to inhalation exposure to coal-fired utility HAP emissions, based on the local analysis, is estimated to be no greater than 3 x 10^{-6}. Arsenic and chromium are the HAPs contributing most to the inhalation risks (see Table ES-3). All other HAPs, including radionuclides, were estimated to present inhalation risks less than 1 x 10^{-6} for coal-fired units.

The cancer incidence in the U.S. due to inhalation exposure to HAPs (including radionuclides) from all 426 coal-fired plants **based on the local analysis** is estimated to be no greater than approximately 0.2 cancer case per year (cases/yr), or 1 case every 5 years. However, as described in later sections, the consideration of longrange dispersion of HAPs (beyond 50 km) results in increased estimates for cancer incidence.

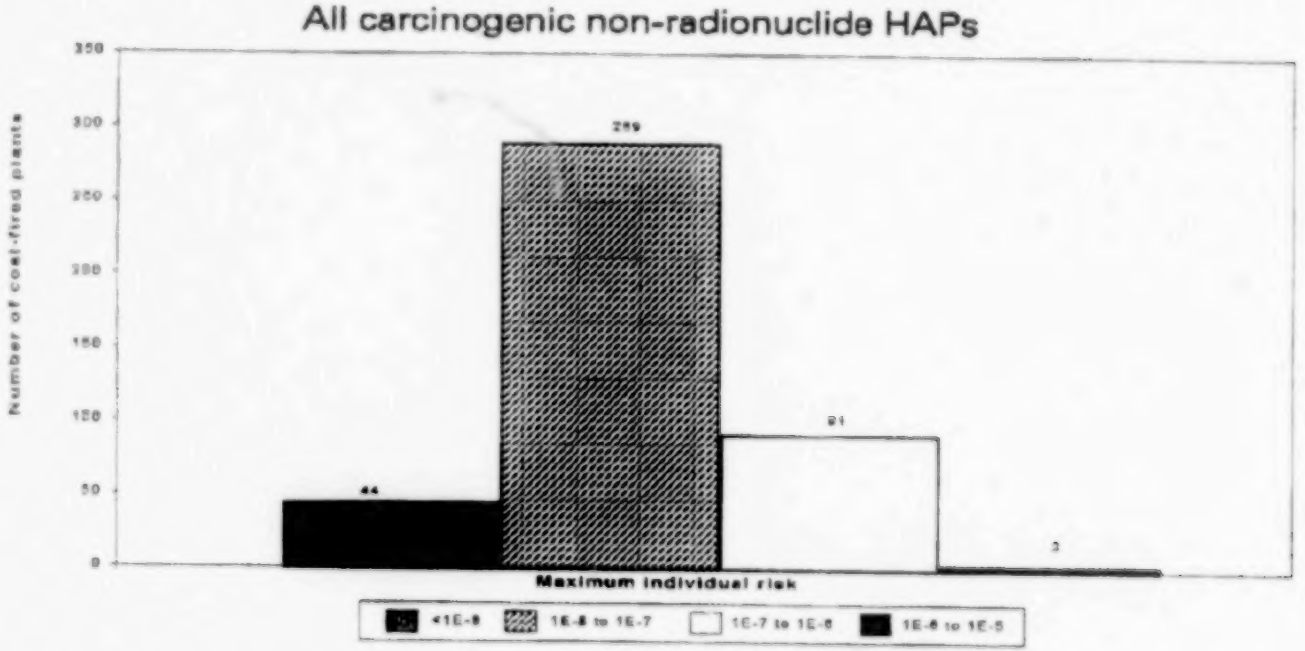
ES.7.2 Inhalation Cancer Risks for Oil-Fired Utilities Based on Local Analysis (1990)

The majority of the oil-fired plants (125 of the 137 plants) are estimated to pose inhalation cancer MIRs less than 1 x 10^{-6}. However, up to 11 of the 137 oil-fired plants are estimated to potentially present inhalation MIRs above 1 x 10^{-6} (see Figure ES-3). Nickel, arsenic, radionuclides, and chromium are the primary contributors to these cancer risks.

For oil-fired utilities, the highest contribution to the MIRs is from nickel. However, there are substantial uncertainties with the nickel risk estimates. Nickel is emitted in several different forms (e.g., nickel oxides, soluble nickel, sulfidic nickel) and the health effects of these different forms vary, and for some forms are unknown or uncertain. Nickel subsulfide (which is one of the possible forms of sulfidic nickel) is a known human carcinogen and appears to be the most carcinogenic form based on available data. Based on limited data, 3 to 26 percent of the nickel emissions are believed to be sulfidic nickel. It is not known how much of the sulfidic nickel emissions are nickel subsulfide. Several other nickel species (e.g., nickel oxides) are also potentially carcinogenic but the potencies are not known.

[Page ES-9]

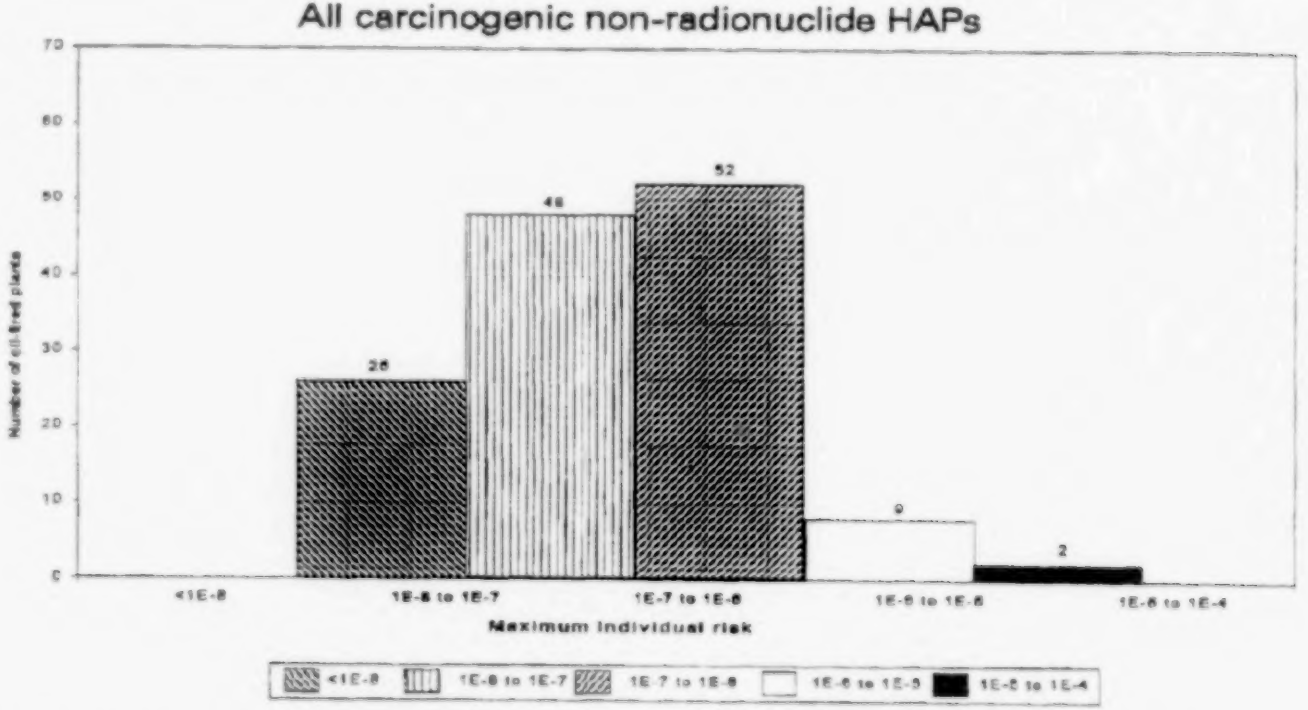
Figure ES-2. Number of Coal-Fired Utilities Posing Various Levels of Maximum Individual Risks (By Levels of MIR)



Note: The high-end maximum individual risks (MIRs) are presented as exponents in this figure. For example, an increased cancer risk of one chance in one million (i.e., 1 x 10^{-6}) is shown as 1E-6 in this Figure. The figure shows that 91 plants are estimated to pose an MIR between 1 x 10^{-7} and 1 x 10^{-6}

[Page ES-10]

Figure ES-3. Number of Oil-Fired Utilities Posing Various Levels of Maximum Individual Risks (By Levels of MIR)



Note: The MIRs are presented as exponents in this figure. For example, an increased cancer risk of 1 x 10 $^{-6}$ is shown as 1E-6 here. The figure shows there are 9 oil-fired plants with estimated MIRs between 1 x 10 $^{-6}$ and 1 x 10 $^{-5}$.

[Page ES-11]

Table ES-3. Summary of High-End Inhalation Cancer Risk Estimates from Local Analysis for Coal-Fired Utilities for the Year 1990

HAP	Highest Cancer MIR[a]	Population with lifetime risk > 1×10^{-6}	Number plants with MIR > 1×10^{-6}
Arsenic	2×10^{-6}	850	2
Chromium	1×10^{-6}	110	1
Total[b] (Aggregate of HAPs)	3×10^{-6}	850	2

[a] Estimated lifetime maximum individual risk (MIR) due to inhalation exposure for the "highest risk" coal-fired plant. Based on an uncertainty analysis, these estimates are considered reasonable high-end estimates (see section ES.7.4 for discussion).

[b] Estimated risk due to inhalation of the aggregate of HAPs assuming additivity of risk for 26 individual carcinogenic HAPs.

[Page ES-11 cont.]

To evaluate the range of potential risks due to nickel emissions, the EPA estimated risks using various assumptions for nickel cancer potency (presented in chapter 6). For example, assuming the nickel mix is 50 percent as carcinogenic as nickel subsulfide, the highest inhalation cancer MIR due to the aggregate of HAP emissions from the highest risk oil-fired utility plant is estimated to be 6×10^{-5}. Assuming the nickel mix is 10 percent as carcinogenic as nickel subsulfide, the highest inhalation cancer MIR due to the aggregate of HAP emissions from the highest risk oil-fired utility plant is approximately 3×10^{-5}. The values in Table ES-4 and Figure ES-3 are based on the conservative assumption that the nickel mix is 50 percent as carcinogenic as nickel subsulfide.

Estimated risks due to inhalation exposure for a subset of HAPs based on the local analysis are presented in Table ES-4. All other HAPs analyzed were estimated to pose inhalation cancer risks below 1×10^{-6} for all 137 oil-fired plants.

The cancer incidence in the U.S. due to inhalation exposure to HAP emissions (including radionuclides) from all 137 oil-fired utilities, based on the local analysis, is estimated to be no greater than 0.5 cancer case/yr.

ES.7.3 Inhalation Cancer Risks Based on Long-Range Transport

In addition to the above analyses, the EPA conducted long-range transport analyses to assess emissions dispersion and exposures on a national scale for 1990. The Regional Lagrangian Model of Air

Pollution (RELMAP) was used to estimate the dispersion of HAP emissions from the facility stack out to the borders of the continental U.S. This is in contrast to the HEM, which estimates dispersion and air concentrations within 50 km of the source.

[Page ES-12]
Table ES-4. Summary of High-end Inhalation Cancer Risk Estimates Based on Local Analysis for Oil-Fired Utilities for the Year 1990

HAP	Highest MIR[a]	Population with lifetime risk $> 1 \times 10^{-6}$	Number plants with MIR $> 1 \times 10^{-6}$
Nickel[b]	5×10^{-5}	110,000	11
Arsenic	1×10^{-5}	2,400	2
Radionuclides	1×10^{-5}	2,400	2
Chromium	5×10^{-6}	2,300	1
Cadmium	2×10^{-6}	45	1
Total[c] (aggregate)	6×10^{-5}	110,000	11

[a] Estimated lifetime maximum individual risk (MIR) due to inhalation exposure for the "highest risk" oil-fired plant. Based on an uncertainty analysis, these estimates are considered reasonable high-end estimates (see section ES.7.4 for discussion).

[b] The estimates for nickel and total HAPs are based on the assumption that the mix of nickel compounds is 50 percent as carcinogenic as nickel subsulfide.

[c] Estimated risk due to inhalation of the aggregate of HAPs assuming additivity of risk for 14 individual carcinogenic HAPs.

[Page ES-12]

The RELMAP modeling was conducted for all coal- and oil-fired utilities, but was limited to mercury, cadmium, chromium, arsenic, nickel, lead, and dioxins. Only inhalation exposures to the carcinogenic HAPs are discussed in this section. Deposition and multipathway concerns are discussed elsewhere in this report. The long-range transport modeling indicates that the local HEM analysis alone does not account for a substantial percentage of the population exposures due to coal-fired utility emissions. A comparison of the HEM results to the RELMAP results indicates a significant portion of emissions disperse further than 50 km, as would be expected for these HAPs, which are mostly fine particulate substances emitted from elevated stacks.

The RELMAP results for arsenic, cadmium, chromium, and nickel (which are emitted mainly as PM) were used to estimate the potential long-range transport inhalation exposures for other carcinogenic HAPs. Using this methodology, the highest cancer incidence due to inhalation exposure to HAPs from coal-fired utilities considering both local and long-range transport is estimated to be up to 1.3 cases/yr, which is about 7 times greater than the incidence estimated in the local analysis alone. The cancer incidence for oil-fired utilities did not change (see Table ES-5).

[Page ES-13] Table ES-5. Summary of High-End Inhalation Risk Estimates Due to Local and Long-Range Transport

LOCAL IMPACTS (dispersion within 50 km of each utility plant)[d]				
	OIL-FIRED PLANTS		COAL-FIRED PLANTS	
Pollutant	Maximum individual risk (MIR)	Annual increased cancer Incidence	Maximum individual risk (MIR)	Annual increased cancer incidence
Radionuclides	1×10^{-5}	0.2	2×10^{-8}	0.1
Nickel[a]	5×10^{-5}	0.2	7×10^{-7}	0.005
Chromium	5×10^{-6}	0.02	1×10^{-6}	0.02
Arsenic	1×10^{-5}	0.04	2×10^{-6}	0.05
Cadmium	2×10^{-6}	0.005	2×10^{-7}	0.0006
All Others[b]	8×10^{-7}	0.005	8×10^{-7}	0.004
Total[c]	6×10^{-5}	0.5	3×10^{-6}	0.2
LOCAL PLUS LONG-RANGE IMPACTS (dispersion from utility emission points to borders of continental U.S.)				
	OIL-FIRED PLANTS		COAL-FIRED PLANTS	
Pollutant	Maximum individual risk (MIR)	Annual increased cancer incidence	Maximum individual risk (MIR)	Annual increased cancer incidence
Radionuclides	1×10^{-5}	0.2	Not estimated	0.7
Nickel[a]	5×10^{-5}	0.2	1×10^{-8}	0.038
Chromium	5×10^{-6}	0.02	2×10^{-6}	0.15
Arsenic	1×10^{-5}	0.05	3×10^{-6}	0.37
Cadmium	2×10^{-6}	0.006	3×10^{-7}	0.005
All Others[b]	8×10^{-7}	0.006	1×10^{-6}	0.028
Total[c]	6×10^{-5}	0.5	4×10^{-6}	1.3

[a] Assumes that the nickel mixture is 50 percent as carcinogenic as nickel subsulfide.

[b] Estimated risks due to exposure to all remaining HAPs analyzed (i.e., excluding nickel, arsenic, chromium, cadmium, and radionuclides).

[c] Aggregate risk (risk due to inhalation exposure to all carcinogenic HAPs, assuming additivity of risks).

[d] There are uncertainties associated with these risk estimates. See sections ES.7.4 for discussion.

A comparison between the HEM local dispersion results and the long-range transport modeling results indicates that long-range transport is much less important for the MIR than it is for cancer incidence. For example, the MIR from the local analyses for coal-fired utilities (i.e., inhalation risk of 3×10^{-6}) is predicted to

[Page ES-14]
increase by roughly 10 to 20 percent to about 4×10^{-6} when ambient concentrations are added from long-range transport of arsenic from all other utilities in the continental U.S. For oil-fired utilities, the long-range transport of HAPs has no impact on the highest inhalation MIR because of the remote location of the two highest risk oil-fired plants.

ES.7.4 Uncertainties with the Inhalation Cancer Risk Assessment

There are several areas of uncertainty in the inhalation risk assessment including: (1) the impacts of long-range transport; (2) the emissions and health effects of different forms of chromium and nickel; (3) the use of a linear non-threshold high-to-low dose extrapolation model for estimating cancer risks at low exposure concentrations; (4) the impacts of episodic releases resulting from upsets or unusual operating conditions; (5) how residence times and activity patterns impact the exposures; (6) the impacts on sensitive subpopulations; (7) the impacts of background exposures; and (8) the risk of complex pollutant mixtures.

The uncertainty analysis indicates that the inhalation cancer MIRs and incidence estimates presented above are reasonable high-end estimates

of the risks due to inhalation exposure within 50 km of each plant. That is, the estimates are considered generally conservative (i.e., predicted to be roughly the 90th to 95th percentile). The uncertainty analysis suggests that the most likely estimated inhalation MIRs (i.e., central tendency MIRs) may be roughly 2 to 10 times lower than the high-end MIRs presented above. The average individual risks due to inhalation exposure to utility HAP emissions for the total exposed U.S. population (roughly 200,000,000 people) are predicted to be roughly 100 to 1,000 times lower than the high-end inhalation MIRs.

ES.7.5 Summary of the Inhalation Cancer Risks

For the majority of utility plants (approximately 671 of the 684 plants), the estimated inhalation cancer risks due to HAP emissions are less than 1 x 10^{-6}. However, several plants (2 coal plants and up to 11 oil plants) are estimated to potentially pose inhalation cancer risks above 1 x 10^{-6}. One oil plant is estimated to pose a high-end inhalation cancer MIR of up to 6 x 10^{-5}. Based on the assessment, no greater than 1.8 cancer cases/yr are estimated to occur in the U.S. due to inhalation exposure to HAP emissions from all coal- and oilfired utilities. Further research and evaluation may be needed to more comprehensively assess the inhalation cancer risks, especially to reduce the uncertainties associated with the nickel risk estimates.

ES.7.6 Inhalation Noncancer Risks

The EPA also assessed noncancer risks (i.e., health effects other than cancer) due to short- and long-term inhalation exposure. Manganese, HCl, HF,

and acrolein were found to be the four HAPs of highest potential concern for noncancer effects.

[Page ES-15]

Based on modeling HAPs for all 684 plants with the HEM, estimated long-term ambient HAP concentrations were generally 100 to 10,000 times below the RfC or similar benchmark. The highest estimated longterm ambient HAP concentration was 10 times below the RfC.

Using a short-term air dispersion model that considers all reasonable meteorological conditions, EPA modeled maximum one-hour concentrations for three HAPs (HCl, HF, and acrolein). The highest short-term exposure was 140 times below the acute reference level.

ES.8 MERCURY MULTIPATHWAY ASSESSMENT

ES.8.1 Background Discussion for Mercury

Mercury cycles in the environment as a result of natural and human (anthropogenic) activities. The amount of mercury mobilized and released into the biosphere has increased since the beginning of the industrial age. Most of the mercury in the atmosphere is elemental mercury vapor, which circulates in the atmosphere for up to a year, and hence can be widely dispersed and transported thousands of miles from likely sources of emission. After it deposits, mercury commonly is emitted back to the atmosphere either as a gas or associated with particles, to be re-deposited elsewhere. As it cycles between the atmosphere, land, and water, mercury undergoes a series of complex chemical and physical

transformations, many of which are not completely understood.

Mercury is a persistent element and bioaccumulates in the food web. Mercury accumulates most efficiently in the aquatic food web. Predatory organisms at the top of the food web generally have higher mercury concentrations. Nearly all of the mercury that accumulates in fish tissue is methylmercury. Inorganic mercury, which is less efficiently absorbed and more readily eliminated from the body than methylmercury, does not tend to bioaccumulate.

Fish consumption dominates the pathway for human and wildlife exposure to methylmercury. The EPA's 1997 Mercury Study Report to Congress supports a plausible link between anthropogenic releases of mercury from industrial and combustion sources in the U.S. and methylmercury in fish. However, these fish methylmercury concentrations also result from existing background concentrations of mercury (which may consist of mercury from natural sources, as well as mercury which has been re-emitted from the oceans or soils) and deposition from the global reservoir (which includes mercury emitted by other countries). Given the current scientific understanding of the environmental fate and transport of this element, it is not possible to quantify how much of the methylmercury in fish consumed by the U.S. population is contributed by U.S. emissions relative to other sources of mercury (such as natural sources and re-emissions from the global pool). As a result, it cannot be assumed that a change in total mercury emissions will be linearly

related to any resulting change in methylmercury in fish, nor over what time period these changes would occur. This is an area of ongoing study.

[Page ES-16]
ES.8.2 Methylmercury Health Effects

Epidemics of mercury poisoning following high-dose exposures to methylmercury in Japan and Iraq demonstrated that neurotoxicity is the health effect of greatest concern when methylmercury exposure occurs to the developing fetus. Dietary methylmercury is almost completely absorbed into the blood and distributed to all tissues including the brain; it also readily passes through the placenta to the fetus and fetal brain. The reference dose (RfD) is an amount of methylmercury, which when ingested daily over a lifetime is anticipated to be without adverse health effects to humans, including sensitive subpopulations. At the RfD or below, exposures are expected to be safe. The risk following exposures above the RfD is uncertain, but risk increases as exposures to methylmercury increase.

Extrapolating from the high-dose exposures that occurred in the Iraq incident, the U.S. EPA derived a RfD for methylmercury of 0.1 microgram per kilogram body weight per day (µg/kg bw/day). While the U.S. EPA was advised by scientific reviewers to employ this RfD for this analysis, new data are emerging. Currently ongoing are two large epidemiology studies in the Seychelle Islands and in the Faroe Islands that were designed to evaluate childhood development and neurotoxicity in relation to fetal exposures to methylmercury in fish-consuming populations. Because of various

limitations and uncertainties in all of the available data, the U.S. EPA and other Federal agencies intend to participate in an interagency review of the human data on methylmercury, including the most recent studies from the Seychelle Islands and the Faroe Islands. The purposes of this review are to refine the estimates of the level of exposure to mercury associated with subtle neurological endpoints and to further consensus between all of the Federal agencies. After this process, the U.S. EPA will determine if a change in the RfD for methylmercury is warranted. (Note: see the 1997 EPA Mercury Study Report to Congress for further discussion and assessment of mercury health effects and public health impacts).

ES.8.3 Mercury Multipathway Exposure Assessment

Mercury was considered highest priority for multipathway exposure analysis. To assess the transport and deposition of mercury emissions from utilities and to estimate concentrations in environmental media and biota, three modeling efforts were undertaken: (1) long-range modeling, (2) local scale modeling, and (3) modeling of environmental concentrations. The RELMAP was used to predict long-range dispersion and deposition across the U.S. For the local analysis, a model designed to predict deposition of HAPs within 50 km, the Industrial Source Complex Version 3 (ISC3) air dispersion model, was used. Next, the EPA's Indirect Exposure Model Version 2M (IEM-2M) was used to estimate mercury environmental concentrations and human exposures. Hypothetical exposure scenarios were evaluated for four model plants (a large coal-fired, a medium coal-fired, a small coal-fired, and a

medium oil-fired utility boiler). The analysis included three types of plant locations: (1) rural (agricultural), (2) near lakes

[Page ES-17]
(lacustrine), and (3) urban. Three human fish consumption scenarios were considered.

The modeling provided information on whether local and/or long-range transport of mercury is significant in a variety of scenarios. The models indicate that most of the mercury from utilities is transported further than 50 km from the source. The fate and transport models provided an assessment of potential inhalation and ingestion exposures.

ES.8.4 Summary of Mercury Assessment Results for Utilities

Recent estimates of annual total global mercury emissions from all sources (natural and anthropogenic) are about 5,000 to 5,500 tons per year (tpy). Of this total, about 1,000 tpy are estimated to be natural emissions and about 2,000 tpy are estimated to be contributions through the natural global cycle of re-emissions of mercury associated with past anthropogenic activity. Current anthropogenic emissions account for the remaining 2,000 tpy. Point sources such as fuel combustion; waste incineration; industrial processes (e.g., chlor-alkali plants); and metal ore roasting, refining, and processing are the largest point source categories on a world-wide basis.

For the year 1994, coal-fired utilities were estimated to emit approximately 51 tpy of mercury in the U.S., which is estimated to be 33 percent of the

158 tpy of airborne anthropogenic emissions of mercury in the U.S. If one assumes that current anthropogenic activity represents between 40 and 75 percent of the total airborne emissions (anthropogenic plus other emissions [e.g., natural emissions]), one can calculate that U.S. utilities emit roughly 13 to 26 percent of the total (natural plus anthropogenic) airborne emissions of mercury in the U.S.

Given the global estimates of 5,000 to 5,500 tpy (which are highly uncertain), U.S. anthropogenic mercury emissions are estimated to account for roughly 3 percent of the global total, and U.S. utilities are estimated to account for roughly 1 percent of total global emissions.

A computer simulation of long-range transport of mercury emissions from all U.S. sources conducted for the EPA's 1997 Mercury Study Report to Congress suggests that about one-third (~ 52 tons) of the 158 tpy of U.S. anthropogenic emissions are deposited, through wet and dry deposition, within the lower 48 States. The remaining twothirds (~ 107 tons) is transported outside of U.S. borders where it diffuses into the global reservoir. In addition, the computer simulation suggests that another 35 tons of mercury from the global reservoir is deposited for a total deposition of roughly 87 tpy in the U.S. Although this type of modeling is uncertain, the simulation suggests that about three times as much mercury is being added to the global reservoir from U.S. sources as is being deposited from it. What is not uncertain is that additional emissions to air will

[Page ES-18]
contribute to levels in the global reservoir and deposition to water bodies.

Long-range transport modeling conducted as part of this Utility Study predicts that approximately 30 percent (15 tpy) of the utility mercury emissions deposit in the continental U.S. The estimated annual deposition rates resulting from utility mercury emissions range from 0.5 to greater than 10 micrograms per square meter. Long-range transport modeling also predicts that the highest deposition occurs in the eastern half of the U.S., particularly areas such as southeastern Great Lakes and Ohio River Valley, central and western Pennsylvania, large urban areas in the eastern U.S. (e.g., Washington, D.C., New York City) and various locations in the vicinity of large coal-fired utilities. Based on the limited available receptor monitoring data, the RELMAP model seems to be accurate within a factor of plus or minus 2. That is, the RELMAP model seems to over- and underestimate mercury values within a factor of two and appears to be relatively unbiased in its predictions.

The modeling assessment in conjunction with available scientific knowledge, supports a plausible link between anthropogenic mercury emissions and mercury found in freshwater fish. As noted above, there are many sources of mercury emissions worldwide, both natural and anthropogenic. The coal-fired utilities are one category of the mercury sources.

Mercury is considered the highest priority for multipathway analyses because it is an

environmentally persistent, toxic element. Mercury is deposited to soil and terrestrial vegetation but at levels that do not result in human exposures likely to be detrimental to health through terrestrial exposure pathways. However, in its methylated form mercury bioaccumulates in the food web (especially the aquatic food web). Modeling results suggest that most of the mercury emitted to the atmosphere is deposited more than 50 km away from the source, especially sources that have tall stacks. As stated above, the modeling assessment from the Mercury Study in conjunction with available scientific knowledge, supports a plausible link between anthropogenic mercury emissions and mercury found in freshwater fish. Additional emissions to air will contribute to levels in the global reservoir and deposition to water bodies. As a result, mercury emissions from utility units may add to the existing environmental burden. At this time, the available information, on balance, indicates that utility mercury emissions are of sufficient potential concern for public health to merit further research and monitoring. The EPA recognizes that there are substantial uncertainties that make it difficult to quantify the magnitude of the risks due to utility mercury emissions, and that further research and/or evaluation would be needed to reduce these uncertainties. Remaining questions include the following: (1) what is the quantitative relationship between a change in U.S. mercury emissions and the resulting change in

[Page ES-19]
methylmercury levels in fish; (2) what are the actual consumption patterns and estimated methylmercury

exposures of the subpopulations of concern; (3) what are the actual mercury levels in a statistically valid and representative sample of the U.S. population and susceptible subpopulations; (4) what exposure levels are likely to result in adverse health effects; (5) what affects the formation of methylmercury in waterbodies and its bioaccumulation in fish; (6) how much mercury is emitted from natural sources and past anthropogenic sources; and (7) how much mercury is removed during coal cleaning and other ongoing practices for pollution control. New data that could reduce some of the uncertainties are likely to become available in the next several years, and EPA plans to review and consider these data, as appropriate, in future decisions.

Regarding potential methods for reducing mercury emissions, the EPA has not identified any demonstrated add-on control technologies currently in use in the U.S. that effectively remove mercury from utility emissions. (However, there may be add-on control technologies used in other source categories that effectively reduce mercury emissions.) Based on available data, total mercury removal by existing PM control devices on coal-fired utilities varies considerably, ranging from 0 to 82 percent removal (with a median efficiency of 15 percent removal) for cold-side electrostatic precipitators (ESPs), and from 0 to 73 percent removal (with a median efficiency of 8 percent removal) for fabric filters. Also, hot-side ESPs exhibited no mercury control. Existing flue gas desulfurization (FGD) units exhibit limited mercury control, ranging from 0 to 62 percent removal, with a median removal of 23 percent. The mercury control

efficiency of FGD units is a function of several factors including temperature, plant configuration, and type of coal. Pilotscale studies have shown that mercury removal can be enhanced through the use of activated carbon injection. However, the limited results to date utilizing carbon injection are inconsistent and more data and research are needed. Other various pollution prevention strategies, such as coal cleaning, have shown some effectiveness in reducing utility emissions of mercury. Conventional coal cleaning removes, on average, approximately 21 percent of the mercury contained in the coal. Also, fuel switching, such as switching from coal to natural gas, would result in decreased emissions of mercury.

ES.9 SCREENING LEVEL MULTIPATHWAY ASSESSMENT FOR ARSENIC

Arsenic is a naturally occurring element found normally, in various concentrations, in soil. In addition, arsenic can also be naturally present in other media (e.g., various food sources and water). Arsenic levels have been measured in a variety of foods. Even though shellfish and other marine foods contain the greatest concentrations of total arsenic, much of the arsenic present in fish and shellfish exists in the less toxic organic form. Other food products, such as meats, rice, and cereals, contain higher percentages, and often higher total amounts, of inorganic arsenic, which is the form of primary toxicological concern.

[Page ES-20]

Arsenic is also naturally present in trace amounts in coal and oil. When coal or oil are burned, some of this naturally occuring arsenic is released to

the atmosphere. The quantity of arsenic released from any utility plant is dependent on many factors including the concentration of arsenic in the fuel, control device efficiency, and other factors.

Utilities emit about 62 tpy of arsenic nationwide, about 3 to 4 percent of the total anthropogenic arsenic emissions in the U.S. Because of its chemical and physical characteristics, arsenic emitted to the atmosphere may be transported to other environmental media (soil or water), thus allowing non-inhalation exposures to occur.

ES.9.1 Exposure Modeling

It was not possible to model every utility plant for arsenic multipathway exposures. Therefore, a screening level model plant approach was used. Four model plants (i.e., a large coal-fired, a medium coal-fired, a small coal-fired, and a medium oil-fired utility boiler) were designed to characterize typical utility plants. In taking the model plant approach, it was realized that there would be a great deal of uncertainty surrounding the predicted fate and transport of arsenic as well as the exposures. However, the assessment was useful for estimating potential risks due to utility arsenic emissions. Three models were used to predict environmental arsenic concentrations and exposure: the RELMAP, the ISC3, and the Indirect Exposure Model Version 2 (IEM-2). These models were used to predict the fate and transport of arsenic emissions and to estimate human exposures to arsenic through multiple exposure routes, including food consumption, water ingestion, and inhalation. Three basic exposure scenarios were considered: a subsistence farmer

(adult and child), a subsistence fisher (adult and child), and a pica child (i.e., a child that ingests significant quantities of soil). These scenarios were considered because they represent possible high-end scenarios for exposure to arsenic.

ES.9.2 Health Effects of Arsenic

Inhalation exposure to inorganic arsenic has been strongly associated with lung cancer in humans. Human exposure to inorganic arsenic, via ingestion, has been associated with an increased risk of several types of cancer, including skin, bladder, liver, and lung cancers. Oral exposure to inorganic arsenic has also been associated with noncancer effects, including effects to the central nervous system, cardiovascular system, liver, kidney, and blood.

ES.9.3 Approach for Estimating Screening Level Arsenic Risks

Increased cancer risks were estimated for each hypothetical scenario, for the four model plants, each of which was placed in two different hypothetical locations (i.e., an eastern humid site and a dry western site). For each of the exposure scenarios, except for the pica child, it is assumed that the hypothetical person is exposed for 30 years. For the pica child, it is assumed that exposure occurs for

[Page ES-21]
7 years. Risks were estimated by multiplying the estimated intakes of arsenic by the EPA's cancer potency factor for arsenic.

ES.9.4 Screening Level Arsenic Risk Assessment Results

The results of the screening level multipathway arsenic exposure assessment provide an indication of the potential hazards and risks that may occur due to emissions from a utility plant. However, the results are not applicable to any particular plant. There are uncertainties and limitations to the analysis.

Exposures to inorganic arsenic due to background levels and due to emissions from the model utility boilers were predicted to be mainly through the ingestion of grains. Exposure to inorganic arsenic through the ingestion of fish was not predicted to be a major pathway of exposure because there is considerable evidence that little of the total arsenic in fish tissue is inorganic arsenic. Soil ingestion is the major route of exposure to inorganic arsenic for the pica child.

ES.9.4.1 Arsenic Cancer Risks. The cancer risks due to multipathway exposures to inorganic arsenic, as estimated in the model plant analysis using hypothetical scenarios, due to utility emissions alone (no background) were estimated to range from 4×10^{-7} to 1×10^{-4}. The highest estimated risk (1×10^{-4}) was for a pica child assumed to be living at the point of maximum deposition. The arsenic emissions from the large coal-fired model utility boiler at the eastern humid site were estimated to pose this highest risk for the pica child. When the risk from background exposure (2×10^{-4}) is added to the maximum risk from utility exposure, the risk for the pica child is

estimated to be up to 3 x 10^{-4}. The "pica child" is considered a highend, conservative scenario.

Background exposures were estimated to dominate the exposures and risks in all scenarios. When considering only the arsenic emissions from the model utility units (not including background), in all scenarios it was the large coal-fired unit that was estimated to pose the greatest multipathway risks and the medium coal-fired unit was estimated to pose the next highest risks. The small coal-fired unit and the oil-fired unit were estimated to present lower risks.

ES.9.4.2 Uncertainty Discussion. There are uncertainties associated with the cancer risk estimates from arsenic. The analysis was based on model plants and hypothetical constructs; therefore, the results are not applicable for any specific utility plant. Further analyses are needed to better characterize the risks posed by arsenic emissions from utilities. A few uncertainties are discussed here.

Exposure to arsenic through the ingestion of tap or well water was not included in this assessment. The exposure modeling assessment was based on a model plant analysis, hypothetical scenarios, and incorporated data with varying degrees of uncertainty. Also, there are uncertainties associated with the health effects data for arsenic.

[Page ES-22]
For example, the animal ingestion studies have not clearly shown an association between arsenic ingestion exposure and cancer.

ES.10 DIOXIN SCREENING LEVEL MULTIPATHWAY ASSESSMENT

The highest MEI inhalation cancer risk due to dioxin emissions from any utility plant based on the HEM analysis (described in section ES.7) was estimated to be 1 x 10^{-7}. The EPA estimates that coal-fired utilities emit 0.2 pounds per year (lb/yr) of dioxin (toxic equivalents, TEQ) and that oil-fired utilities emit 0.01 lb/yr. These estimates combined are roughly 1 percent of the nationwide anthropogenic dioxin emissions. However, dioxin emissions data were only available for twelve utility plants and 42 percent of the measurements were below the minimum detection limit. Moreover, dioxins are not part of the naturally occuring fossil fuel. They are formed in highly complicated reactions which may occur with unknown frequency during combustion. Therefore, the emissions data for dioxins from utilities, which are the basis of exposure modeling, are considered more uncertain than the emissions data for many of the other HAPs.

For the screening level multipathway analysis, the transport, deposition, multipathway exposures, and human cancer risks were assessed for utility emissions of polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs), collectively referred to as dioxins. Atmospheric deposition of dioxin emissions can be important because dioxins tend to persist in the environment and bioaccumulate in the food web. Environmental persistence and bioaccumulation, coupled with carcinogenic effects at very low levels,

make multipathway exposure an important consideration for dioxins.

ES.10.1 Methods

The basic approach for estimating screening level multipathway exposures to dioxins was similar to the methods described above for mercury and arsenic. However, there were some differences. The EPA's ISCST3 model was used to predict deposition and air concentrations of dioxins within 50 km of each of four model plants. Model plants were selected to represent both large and small coal- and oil-fired utilities. A modified version of the IEM spreadsheet model was used to estimate environmental concentrations, exposures to the environmental concentrations for 16 hypothetical human scenarios, and the resulting cancer risks. Pathways assessed include inhalation, dermal contact with soil, and ingestion of water, soil, fish, plants, and animals.

ES.10.2 Results

Since the analysis was based on model plants, using hypothetical scenarios, the results are not applicable to any specific plant and contain substantial uncertainties about the risks due to dioxin emissions. Total modeled screening level lifetime cancer risks related to multipathway exposure to dioxins for the four-model plant analysis ranged from 1×10^{-10} to 2×10^{-4}. The results of this

[Page ES-23]
analysis indicate that the exposures and risks due to fish consumption are the highest of all pathways considered. The highest modeled result of 2×10^{-4} lifetime cancer risk was obtained for the subsistence fisher exposure scenario. In all modeled scenarios,

the noninhalation exposures were at least one order of magnitude larger than the inhalation exposures, thus demonstrating the potential significance of including multipathway exposure analysis in the risk assessments for pollutants that are environmentally persistent and tend to bioaccumulate. Also, unlike the results for arsenic, modeled exposures to dioxins for each pathway exceed the background exposure estimates for dioxins.

ES.10.3 Uncertainty Discussion

Several sensitivity analyses were completed for the screening level multipathway assessment of utility dioxin risks to assess the reasonableness of the results. The assumptions with the greatest impact on the predicted risk to the subsistence fisher were those made about the biota-sediment accumulation factor. This sensitivity analysis suggests that the modeling results are reasonable for a screening level analysis.

ES.11 MULTIPATHWAY ASSESSMENT FOR RADIONUCLIDES

Radionuclide emissions from utilities may result in human exposure from multiple pathways including: (1) external radiation exposure from radionuclides suspended in air or deposited on the ground, and (2) internal exposure from the inhalation of airborne contaminants or ingestion of contaminated food. The CAP-93 model was used to estimate multipathway exposures and risks due to radionuclide emissions to humans within 50 km of all 684 utilities. However, this assessment did not use site-specific data for the non-inhalation exposure

analysis, but rather relied on various generic assumptions and general input data.

Based on the CAP-93 modeling, 667 of the 684 plants are estimated to pose multipathway risks less than 1 x 10^{-6}. The highest estimated multipathway radiation exposure for the MEI due to radionuclide emissions from utilities was predicted to be 1.5 millirems (mRems) per year, which is estimated to pose an increased cancer risk of 3 x 10^{-5}. Seventeen plants (13 coal- and 4 oil-fired plants) were estimated to pose multipathway risks between 1 x 10^{-5} and 3 x 10^{-5}. The estimated cancer incidence in the U.S., due to emissions and dispersion of radionuclides within 50 km of each utility, is estimated to be 0.3 cancer deaths/yr. The cancer incidence appears to be mostly due to inhalation exposure. The non-inhalation exposures contribute only slightly to the incidence. The non-inhalation exposure pathways have a greater impact on the MEIs, especially for coal-fired plants.

The risks due to exposure to radionuclides from utilities are substantially lower than the risks due to natural background radiation. The average exposure to natural background radiation (excluding radon) for the U.S. population has been estimated to be

[Page ES-24]
roughly about 100 mRems per year, which is about 67 times higher than the highest exposure due to utility radionuclide emissions.

ES.12 QUALITATIVE MULTIPATHWAY EXPOSURE ASSESSMENT

The EPA recognizes that non-inhalation exposure pathways could be important for additional HAPs that are persistent and tend to bioaccumulate. A few additional HAPs that were not modeled for multipathway exposures are discussed below.

ES.12.1 Cadmium and Lead

Cadmium emissions from the vast majority of plants (683 of the 684 plants) are estimated to pose inhalation risks less than 10^{-6}, and the highest modeled air concentration of lead was 200 times below the national ambient air quality standard (NAAQS). Cadmium and lead are persistent, may bioaccumulate, and are toxic by ingestion. However, since the emission quantities and inhalation risks are relatively low, the EPA does not plan to conduct future evaluations of multipathway exposures of cadmium and lead from utilities.

ES.12.2 Nickel and Chromium

Nickel and chromium were not considered to be priority for noninhalation exposures. At relatively high oral doses, nickel and chromium do cause noncancer toxicity. However, there are considerable uncertainties about the noncancer toxicity of nickel and chromium at relatively low ingestion doses (below the toxic threshold). Also, it is uncertain whether they pose a carcinogenic risk by ingestion. Hence, EPA does not plan to assess multipathway exposures for nickel and chromium for utilities.

ES.13 POTENTIAL IMPACTS OF HYDROGEN CHLORIDE AND FLUORIDE

No exceedances of the health benchmarks (e.g., RfCs) for HCl or HF were identified in the inhalation exposure assessment. However, emissions of HCL and HF may contribute to acid deposition and, to a lesser extent to PM fine and visibility problems. To the extent that these emissions may contribute to such problems, they could be addressed through other Titles of the Act.

ES.14 ALTERNATIVE CONTROL AND PREVENTION STRATEGIES

There are numerous potential alternative control strategies for reducing HAPs. These include precombustion controls (e.g., fuel switching, coal switching, coal cleaning, coal gasification), combustion controls, post combustion controls (e.g., PM controls, SO^2 controls), and approaches that prevent pollution by improving efficiency in supply (e.g., promoting energy efficiency in combustion) or demand (e.g., demand side management [DSM], pollution prevention, energy conservation). The degree of feasibility, cost, and effectiveness of each of these potential control technologies varies. For example, coal cleaning tends to remove at least some of all the trace metals, with lead concentrations being removed to the greatest

[Page ES-25]
extent (averaging approximately 55 percent removal) and mercury being removed the least (averaging approximately 21 percent). Existing PM controls tend to effectively remove the trace metals (with the

exception of mercury) while FGD units remove trace metals less effectively and exhibit more variability. Fuel switching (e.g., switching from coal to natural gas) could result in substantial reductions in HAP emissions. There are few existing data that show the HAP reduction effectiveness of DSM, pollution prevention, and energy conservation. These control strategies need to be examined further for technical and economic considerations.

ES.15 OTHER ISSUES AND FINDINGS

ES.15.1 Emissions and Risks for the Year 2010

In addition to the 1990 analysis, the EPA also estimated emissions and inhalation risks for the year 2010. There are substantial data gaps and uncertainties in the projections to the year 2010. However, the approach utilized is reasonable given the limitations of data to complete such projections.

Based on EPA's assessment for this report, HAP emissions from coal-fired utilities are predicted to increase by 10 to 30 percent by the year 2010. Predicted changes that were included in the 2010 emissions projections include the installation of scrubbers for a small number of facilities, the closing of a few facilities, and an increase in fuel consumption of other facilities. However, based on EPA's exposure modeling analysis for the year 2010, the inhalation risks in 2010 for coal-fired utilities are estimated to be roughly equivalent to the 1990 inhalation risks. For oil-fired plants, emissions and inhalation risks are estimated to decrease by 30 to 50 percent by the year 2010. Multipathway risks for 2010 were not assessed. Utilization of add-on controls to comply with the acid rain program are not

expected to significantly impact on HAP emissions due to their limited numbers and limited HAP control efficiency improvement. However, if additional actions are taken to reduce emissions of criteria pollutants, acid rain precursors, or global warming compounds (e.g., use of fuel switching or add-on controls to reduce SO_x, NO_x, and/or carbon dioxide emissions), these actions could result in reductions in HAP emissions. For example, analyses performed to assess compliance with the revised NAAQS for ozone and PM indicate that mercury emissions in 2010 may be reduced by approximately 16 percent (11 tpy) over those projected in this report. Other potential (but unknown) actions (e.g., repowering, restructuring) may have a significant impact on HAP emissions; however, these unknowns were not included in the 2010 projection.

ES.15.2 Peer Review

Draft versions of Chapters 1 through 9 and 13 of this report and draft technical support documents were reviewed by many non-EPA scientists representing industry, environmental groups, academia, and other parties. Chapters 10, 11, and 12 are new chapters produced in response to major comments from the reviewers. EPA held a scientific

[Page ES-26]
peer review meeting and also a public meeting in July 1995 to obtain comments from reviewers. In February, April, and September 1996, all sections of the draft report underwent additional review by EPA, State and local Agencies, and other Federal Agencies. Additional review occurred during 1997. The EPA has revised the report, as appropriate,

based on the reviewers' comments. However, there were several comments that could not be fully addressed because of limitations in data, methods, and resources. In addition, there were some comments that EPA did not agree with. Also, the new chapters (10 to 12) have only undergone a limited review. Draft versions of this report, along with all the comments received, have been submitted to the public docket (A-92-55) at the following address: U.S. EPA, Air and Radiation Docket and Information Center, mail code 6102, 401 M Street, S.W., Washington, D.C. 20460; telephone number (202) 260-7548. Materials are available for public review at the docket center or copies may be mailed (for a fee) on request by calling the above number.

ES.15.3 Industry Report

If alternative methods and assumptions were used to study the HAP emissions from utilities, the results would likely be somewhat different. To assess the impact of using alternative assumptions and methods, it is useful to compare the EPA study with a similar study completed by the EPRI.

The EPRI prepared a report, entitled "Electric Utility Trace Substances Synthesis Report," (November 1994) that paralleled the EPA's study. Many of the same emissions data were used and similar risk assessment methods were utilized. The EPRI study concluded that cancer inhalation risks are below 1×10^{-6} for all utilities, and noncancer inhalation risks are well below Federal threshold levels for all utilities. Population inhalation risks were determined by the EPRI to be insignificant (less than 0.1 cancer case/year). Case studies at four

plants found that multimedia risks, including mercury, are below levels of concern.

The EPRI's risk estimates are generally similar to, but in several cases lower than, those of EPA. Differences between the studies include: (1) EPA's use of a higher unit risk factor for arsenic; (2) EPA's assumption that nickel was carcinogenic (EPRI assumed nickel was not carcinogenic); (3) EPA's evaluation of exposure beyond 50 km to all locations in the U.S. (EPRI did not attempt this analysis); (4) EPRI's radionuclide analysis was based on several model plants, while the EPA evaluated every plant in the U.S.; and (5) the EPRI assumed that chromium emissions were five percent chromium VI (the carcinogenic form), while EPA assumed that 11 percent (for coalfired plants) and 18 percent (for oil-fired plants) were chromium VI. In addition, the EPRI mercury multimedia study considered only the local impact from four plants (not worst-case) and did not include potential impacts of total nationwide utility mercury emissions and contributions to total environmental loadings.

[Page ES-27]

ES.15.4 Potential Environmental Impacts Not Included in Study

There are other potential environmental issues associated with utilities not assessed in this report. These include: (1) the impacts of criteria pollutants (SO_2, NO_x, PM, carbon monoxide, and ozone) or acid rain precursors (SO_2 and NO_x), which are studied and regulated under other sections of the Act; (2)an assessment of ecological impacts of HAPs; (3) the impacts of carbon dioxide emissions and climate; and

(4) the impacts resulting from restructuring, mining, drilling, solid waste disposal, transmission, transportation, or other activities associated with electric power generation. These issues and potential impacts were not assessed because they were considered beyond the scope of this study as mandated by Section 112(n) of the Act.

ES.15.5 Link to Particulate Matter

Arsenic, cadmium, chromium, lead, nickel, radionuclides, and several other HAPs are emitted primarily as PM. Consequently, these HAPs may contribute to PM emissions and PM health concerns, especially from poorly controlled coal-fired units and uncontrolled oil-fired units (about two-thirds of oil-fired units are uncontrolled for PM). Impacts for PM were not addressed in this study, but are being studied under Title I of the Act. If additional controls of PM emissions are utilized, this could result in reductions in HAP emissions.

ES.16 OVERALL TECHNICAL SUMMARY AND CONCLUSIONS

Based on available information and current analyses, the EPA believes that mercury from coal-fired utilities is the HAP of greatest potential concern and merits additional research and monitoring. There are uncertainties regarding the extent of risks due to mercury exposures including those from utility emissions. Further research and evaluation are needed to gain a better understanding of the risks and impacts of utility mercury emissions. In addition, further research and evaluation of potential control technologies and strategies for mercury are needed.

For a few other HAPs, there also are still some remaining potential concerns and uncertainties that may need further study. First, the screening multipathway assessments for dioxins and arsenic suggest that these two HAPs are of potential concern (primarily from coal-fired plants); however, further evaluations and review are needed to better characterize the impacts of dioxins and arsenic emissions from utilities. Second, nickel emissions from oil-fired utilities are of potential concern, but significant uncertainties still exist with regards to the nickel forms emitted from utilities and the health effects of those various forms. The impacts due to HAP emissions from gas-fired utilities are negligible based on the results of this study; therefore, the EPA feels that there is no need for further evaluation of the risks of HAP emissions from natural gas-fired utilities.

[Page ES-28]

ES.17 AREAS FOR FURTHER RESEARCH AND ANALYSIS

There are many uncertainties and data gaps described throughout this report. This section summarizes several important areas in which further research or scientific work may be needed.

ES.17.1 Emissions Data for Dioxins

Emissions data for dioxin compounds were available from less than 12 utility plants. Many of the measurements were near the detection limits. Therefore, there are greater uncertainties with the dioxin emissions than for the other HAPs. Research may be needed to gain a better understanding of the dioxin emissions from utilities and the dioxin

formation, if any, in various utility boiler types (e.g., units with cold-side or hot-side ESPs).

ES.17.2 Speciation of Nickel

There are significant uncertainties regarding the forms of nickel emitted from oil-fired utilities and their associated health effects. Research would be useful to determine the emissions quantities of various nickel forms and the health effects of various nickel forms.

ES.1.7.3 Multipathway Risk Assessment

Further work may be needed to better characterize the risks due to multipathway exposure to certain HAPs (e.g., arsenic and dioxins).

ES.17.4 Local, Regional, and Long-range Transport Exposures

Further modeling and evaluation may be needed to better characterize the impacts of local, regional, and long-range transport of HAPs from utilities.

ES.17.5 Mercury

There are numerous areas regarding mercury that may need further research, study, or evaluation. A few potential areas for further study include the following:

(1) additional data on mercury content of various types of coal;

(2) improved methods for measuring mercury levels in water;

(3) the impact of reducing mercury emissions from coal-fired facilities on the bioaccumulation of mercury in fish;

(4) statistically valid and reliable estimates of methylmercury exposure levels in the U.S. population and susceptible subpopulations, as measured in human hair;

(5) the occupational, dietary and behavioral factors that affect mercury exposures for people who are determined to be exposed above a threshold of concern;

(6) the human health and environmental benefits that would be expected by reducing mercury emissions from U.S. utilities;

[Page ES-29]

(7) control technologies or pollution prevention options that are available, or will be available, that could potentially reduce mercury emissions and what are the costs of those options;

(8) how do other regulations, programs and activities (e.g., acid rain program, electricity restructuring, NAAQSs, and climate change) affect mercury emissions; and

(9) additional data on mercury emissions (e.g., how much is emitted from various types of units, how much is divalent vs elemental mercury, and how do factors such as control device, fuel type, and plant configuration affect emissions and speciation).

Several additional uncertainties and potential areas for further research on mercury are discussed in other sections of this report.

ES.17.6 Projections to the Year 2010

There are significant uncertainties and unknowns in the emissions and risk projections made to the year 2010 (e.g., impact of electricity restructuring; impact of State efforts to regulate such restructuring; impact of any climate change abatement initiatives). Research and evaluation in these areas may be needed.

ES.17.7 Ecological Risks

The effects of HAPs on wildlife, endangered species, and terrestrial and aquatic ecosystems were not evaluated in this study. Although not mandated by section 112(n)(1)(A), further evaluation of ecological risks due to HAP emissions would be needed to fully evaluate the impacts of utility HAP emissions.

ES.17.8 Criteria Pollutant and Acid Rain Programs

Further evaluation is needed to assess the impacts of the Acid Rain and Criteria Pollutant programs (e.g., impact of revisions to the PM-fine and ozone NAAQS; impact of Ozone Transport Assessment Group [OTAG] activities) on HAP emissions, especially for mercury

[Page 2-25]

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2.7 UTILITY INDUSTRY AFTER IMPLEMENTATION OF 1990 AMENDMENTS

This section describes the changes in the utility industry expected during the 1990–2010 time frame. The effect of planned generation capacity growth on the fuel use and technologies that will be used for steam and power generation is discussed in section 2.7.1. Title IV of the Act requires the utility industry to reduce SO^2 emissions in two phases. The effect of SO^2 control measures likely to be used to comply with the Phase I and Phase II requirements on the overall mix of utility SO control technology is discussed in section 2.7.2. For the purposes of this analysis, the projected compliance date for Phase II was determined to be 2010. This year was chosen after discussions with Agency, nonagency, and industry sources concerning possible delays written into Title IV of the Act.

Title IV also contains other provisions that will affect utility responses to regulations. These revisions include topics such as permitting, monitoring, enforcement, repowering, and penalties. Although these provisions affect the manner in which the utility industry will respond to regulations, they are generally subsidiary to emissions estimates based on fuel usage. These provisions are not discussed further here.

Since the Interim Final Report to Congress, the EPA has obtained and analyzed current information and future projections on energy production (by fuel)

in the electric utility industry.86 It appears that the fuel usage projections listed below are being met and are proceeding toward what the EPA (using the Acid Rain Division's [ARD] model projections) predicted in the Interim Final Report to Congress. Therefore this section and the 2010 projected emissions were not changed in this Final Report.

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[Page 2-31]

The Agency projects that 135 units will be retired during the period from 1990 to 2010. These units have been removed from the 2010 analyses.

2.7.2 Title I and Title IV, Phase I and Phase II, Compliance Strategy Impact

Phase I and Phase II requirements of the Acid Rain Program establish a cap on the national, annual SO_2 emissions. To achieve 2 compliance with the requirements, utilities may use one or any combination of the following strategies (among others) at any given unit: (1) install flue gas scrubbers, (2) switch to a fuel that contains less sulfur, and (3) reduce the capacity factor of the Phase I unit to the extent that the unit is in compliance and provide plans for replacing the reduced capacity. This reduction can be accomplished by either: (1) energy conservation, (2) improved boiler efficiency, (3) use of a designated sulfur-free (nuclear or hydro, but not natural gas-fired) replacement, (4) use of a Phase II compensating unit, or (5) purchase of emission allowances.

The Phase I requirements affected 261 generating units (435 with substitution or compensating generating units).[95] The 174 substitution or compensating generating units are not included in the following discussion. Examining the method used by the 261 Phase I generating units to comply with the provisions, the following was found:[96]

- 53 percent (136 units accounting for 59 percent of the 1995 SO_2 emission reductions) switched to a coal that contains 2 less sulfur

- 27 percent (83 units accounting for 9 percent of the 1995 SO_2 emission reductions) purchased additional emission 2 allowances

- 16 percent (27 units accounting for 28 percent of the 1995 SO_2 emission reductions) installed flue gas scrubbers

- 2 percent (7 units accounting for 2 percent of the 1995 SO_2 emission reductions) were retired

- 2 percent (8 units accounting for 2 percent of the 1995 SO_2 emission reductions) either repowered using new boiler technology, or switched to natural gas or low sulfur oil.

Each of the 27 units known to be installing scrubber units was modeled with the scrubber unit in place for the 2010 scenario. The EPA modeled the remaining 234 units by increasing their coal consumption in proportion to ICF Resources, Inc. (2010) projections. These increases were also weighted by the expected increased use of western, low-sulfur coal.

Under Phase II of the Acid Rain Program, an additional approximately 1,600 generating units will be covered by the year 2000.

[Page 2-32]
Although industry projections suggest an additional 25 units (at 10 plants) will install scrubbers to

comply with Phase II, the EPA believes that these units will comply with Phase II requirements by using alternate methods.[97] This assumption is based on several factors including: (1) the increased availability of low-sulfur coal at favorable prices; (2) the introduction of processes that reduce SO_2 emissions by 20 to 50 percent through partial cleaning of higher sulfur coal, which allows for a variety of coal types to be utilized (although the impact of these processes as Title IV control options is uncertain at this time); and (3) the increased age and small size of the affected units, giving the utility companies little incentive to spend large amounts of capital on installing scrubbers.[98]

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[Page 6-1]

6.0 INHALATION RISK ASSESSMENT

6.1 BASELINE ASSESSMENT OF INHALATION EXPOSURES AND RISKS FOR 13 PRIORITY POLLUTANTS

This chapter presents estimates of risks due to inhalation exposure to 13 of the 14 priority HAPs identified in the screening assessment (chapter 5). The assessment of risks presented in this chapter is more refined and complete than the screening level assessment presented in chapter 5. The risk estimates presented in this chapter are believed to be more accurate and more comprehensive than those presented in chapter 5. However, it is important for the reader to understand that the risk estimates presented in this chapter are still generally considered high-end estimates, and there are still substantial uncertainties and data gaps in the risk assessment presented in this chapter. Further assessment would be needed in several areas to gain a better understanding of the actual risks posed by electric utilities.

Radionuclides were the one priority HAP not included in this chapter because the analysis for radionuclides requires an air dispersion model that predicts the impacts of the radioactive decay process. The radionuclide analysis is presented in chapter 9. In this section, for the 13 priority HAPs, risks have been calculated using the HEM for HAP emissions from all 684 utilities, and using the standard HEM default options and assumptions described in chapter

4. The HEM estimates ambient air concentrations within 50 km of each utility. Therefore, the baseline risk estimates reflect only inhalation exposure within 50 km of each utility (i.e., local analysis). In addition, the baseline risks presented in section 6.1 do not account for background levels, long-range transport, complex terrain, indirect exposures, or overlapping plumes. These issues are analyzed and discussed in later sections of the report.

Not incorporating the above factors may lead to underestimating risks. However, there are several important assumptions that were incorporated into the baseline assessment that are generally conservative (i.e., more likely to overestimate rather than underestimate risks). For example, the baseline assessment assumes that MEIs are exposed to the modeled concentrations for 70 years. Also, the cancer potency values (i.e., IUREs) that were used in this assessment are considered "upper limit" estimates.[1] The IUREs represent upper bound estimates of the cancer risks posed by these HAPs. The true risks are not known and could be as low as zero. These are just a few of the assumptions and uncertainties associated with the baseline assessment. Later sections describe many of the data inputs and default assumptions and discuss various issues and uncertainties.

The HEM exposure modeling conducted for the screening assessment (chapter 5) was very similar to the HEM exposure modeling conducted for the baseline assessment (this section). The same default options

[Page 6-2]
described in chapter 4 and same input data were used. However, there is one important difference. For the baseline assessment, a distinction was made between urban and rural locations. If a utility plant is located in an urban area, it was modeled using the urban mode (i.e., dispersion is assumed to be characteristic of emissions emitted by a facility in an urban location where there are buildings nearby). If a utility plant is located in a rural location, it was modeled using the rural mode (i.e., dispersion is assumed to be characteristic of a facility located in a rural location). Dispersion of the pollutant plume in an urban area is expected to exhibit greater turbulence because of heat transfer and obstacles (i.e., large buildings). Therefore, using the urban default setting typically results in higher predicted air concentrations as compared to the concentrations predicted using the rural default setting. In the screening assessment, all plants were modeled using the urban default because using the urban default typically leads to more conservative estimates of human exposures and risks. However, using the urban and rural distinction is believed to reflect more realistic conditions; therefore, it was considered appropriate to use the urban versus rural distinction in the baseline assessment, and in subsequent HEM modeling analyses presented throughout chapter 6. The urban and rural options (which differ in the assumptions for surface roughness) and their impact on the risk estimates are discussed in detail in section 6.2.

The uncertainty analysis (presented in later sections of chapter 6) suggests that the baseline risk

estimates are generally conservative, but within the range of reasonable estimates. Therefore, the results presented in this section (baseline risk estimates) are generally considered reasonably high-end estimates of the risks due to inhalation exposure of utility HAP emissions within 50 km of the utility plants. This conservatism is considered appropriate given EPA's mandate of public health protection. Central tendency estimates of risks as well as background exposures and risks are discussed, and analyzed to a limited degree, in later sections of this chapter.

6.1.1 Baseline Inhalation Risks for Coal-Fired Utilities for Priority HAPs

A total of 426 coal-fired units were modeled with the HEM using 1990 emissions and population data. Two of the plants resulted in individual risks less than 1×10^{-9} and were excluded from the presentation of results, thus reducing the total number of plants to 424. Table 6-1 summarizes the following: the predicted high-end MEI risks; high-end MIRs; the high-end estimate of the number of persons predicted to be exposed above individual cancer risk levels of 1 chance in 1 million (i.e., 1×10^{-6}); the number of plants whose emissions result in those risk levels; and the maximum HQs.

6.1.1.1 Individual Cancer Risk. Table 6-1 presents the estimated risks due to inhalation exposure within 50 km for each HAP across all coal-fired plants. As stated previously, the MEI is

[Page 6-3]

Table 6-1. Summary of High-End Risk Estimates from Chronic Inhalation Exposure by HAP for 424 U.S. Coal-Fired Utilities Based on the Baseline Inhalation Risk Assessment

Pollutant	Carcinogens					Noncarcinogen
	Highest MEI cancer risk[a]	Highest cancer MIR[b]	Population with risk $>10^{-6}$	# Plants with MIR $>10^{-6}$	Cancer incidence (cases/yr)[c]	Max. HQ
Arsenic	3×10^{-6}	2×10^{-6}	850	2	0.05	NA
Beryllium	3×10^{-7}	2×10^{-7}	0	0	0.004	NA
Cadmium	2×10^{-7}	1×10^{-7}	0	0	0.0006	NA
Chromium[d]	2×10^{-6}	1×10^{-6}	110	1	0.02	NA
Dioxin/furans	5×10^{-8}	3×10^{-8}	0	0	0.001	NA
Hydrogen chloride	NA	NA	NA	NA	NA	0.1
Lead	NA	NA	NA	NA	NA	0.001
Manganese	NA	NA	NA	NA	NA	0.05
Mercury	NA	NA	0	0	NA	--
Nickel[e]	4×10^{-7}	2×10^{-7}	0	0	0.003	NA
Total	4×10^{-6}	3×10^{-6}	NA	2	0.1	0.1 to 0.2

HQ = Hazard quotient, the ratio of exposure concentration to the reference concentration (RfC). HQ values below 1 are not expected to result in adverse effects.

MEI = Maximally exposed individual, which is calculated using the highest annual average concentration predicted with the HEM. An individual may or may not be exposed at that point. This value may be greater than the MIR.

MIR = Maximum individual risk is the highest risk identified at the centroid of a census tract to which a population is assigned. See chapter 4 for description of MEI and MIR.

NA = Not available.

[Page 6-3 cont.]
Total = Total MEI are the sum of MEI for individual HAPs within a plant. The total HQ (=HI) is the sum of the HQs within a plant.

[a] Of all 424 coal-fired plants modeled with the HEM, this is the estimated increased inhalation cancer risk for a theoretical person assumed to be exposed for 70 years to the highest modeled HAP ambient air concentration around any of the 424 plants.

[b] Of all 424 coal-fired plants modeled with the HEM, this is the highest MIR.

[c] The cancer incidence could be up to roughly 7 times greater when considering the impacts of long-range transport (i.e., exposure outside of 50 km) from all coal-fired utilities combined. See section 6.6 for discussion of long-range transport.

[d] Assumes that 11 percent of total chromium emitted is hexavalent chromium, the species of chromium responsible for carcinogenic potential. Trivalent chromium, which would also be present, is assumed not to have carcinogenic effects.

[e] The nickel emitted is a mixture of various nickel compounds such as soluble nickel. This analysis assumes that the mix of nickel compounds emitted is 50% as carcinogenic as nickel subsulfide.

[Page 6-4]

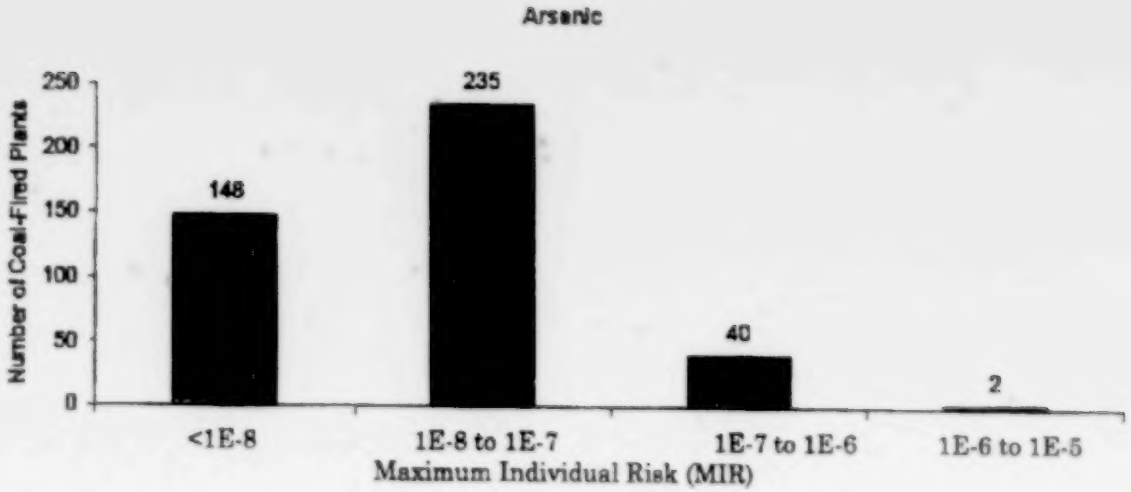
MIRs greater than or equal to 10^{-6}. The MIRs for the remaining 424 coal-fired plants were lower than 1×10^{-6}. Figures 6-1a and 6-1b show that most inhalation risks were considerably lower than 1×10^{-6}. The risk for chromium assumes that 11 percent of total chromium is hexavalent chromium, (a Class A, human carcinogen). The limited emissions speciation data (described in Appendix H of the EPA Interim Final Utility Report, Volume III)[2] found hexavalent chromium between 0.3 and 34 percent of total chromium. The average percentage of chromium VI based on limited speciation data was 11 percent. The other HAPs do not appear to make a significant contribution to the MIR from coal-fired plants. Figures 6-1a and 6-1b present the distribution of plants at different MIR levels for the major carcinogens. Arsenic and chromium are the major contributors of inhalation cancer risks from coal-fired utilities. Of the 424 coalfired plants, the median MIR is 2×10^{-8} for arsenic and 2×10^{-9} for chromium. The 90th percentile MIR of all 424 plants modeled is 1×10^{-7} for arsenic and 4×10^{-8} for chromium (that is, 10 percent of the plants have MIR levels above, and 90 percent of the plants have MIR levels below, these risk levels).

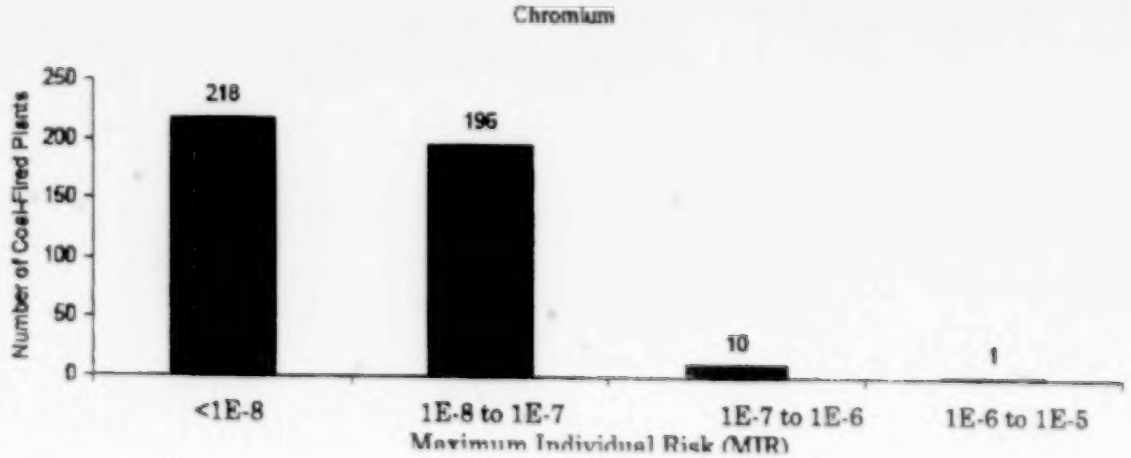
The total MIR due to inhalation exposure to the aggregate of HAPs for each plant was calculated by summing the MIR for each HAP for each plant. There are two coal-fired plants with total MIRs greater than 1×10^{-6}. The highest total MIR for a single coal-fired plant is 3×10^{-6}. Of the 424 coal-fired plants modeled, the median total MIR is 5 x

10^{-8}, and the 90th percentile is 2×10^{-7} (that is, 10 percent of plants pose an MIR greater than 2×10^{-7}).

6.1.1.2 Population Cancer Risk. The population distribution at various risk levels is shown in Table 6-2 for each of the five major carcinogenic HAPs. As with the MIR, arsenic and chromium are the major contributors. The high-end estimate of number of people exposed to risks of 1×10^{-6} or greater from exposure to arsenic is 850 and from exposure to chromium is about 107. That is, based on this assessment, it is unlikely that more than 850 people are exposed to inhalation risks greater than 1×10^{-6} due to coal-fired utility nonradionuclide HAP emissions, and most likely fewer people are exposed (possibly as few as zero) to this level of inhalation risk.

The HEM also calculated the annual incidence of cancer expected for each of the HAPs due to inhalation exposure within 50 km. As shown in Table 6.1, the high-end estimate for total cancer incidence from the nonradionuclide carcinogenic HAPs was estimated, using the HEM, to be as high as 0.1 cancer case per year for coal-fired plants due to emissions within 50 km of each plant. However, the estimate for incidence increases by about a factor of seven when considering emissions dispersion beyond 50 km (see section 6.6). Arsenic and chromium are again the major contributors and account for almost 90 percent of the estimated cancer incidences.


Arsenic
Number of Coal-Fired Plants
250
200
150
100
50
0
148
235
40
2
<1E-8
1E-8 to 1E-7
1E-7 to 1E-6
1E-6 to 1E-5
Maximum Individual Risk (MIR)


Chromium
Number of Coal-Fired Plants
250
200
150
100
50
0
218
196
10
1
<1E-8
1E-8 to 1E-7
1E-7 to 1E-6
1E-6 to 1E-5
Maximum Individual Risk (MIR)

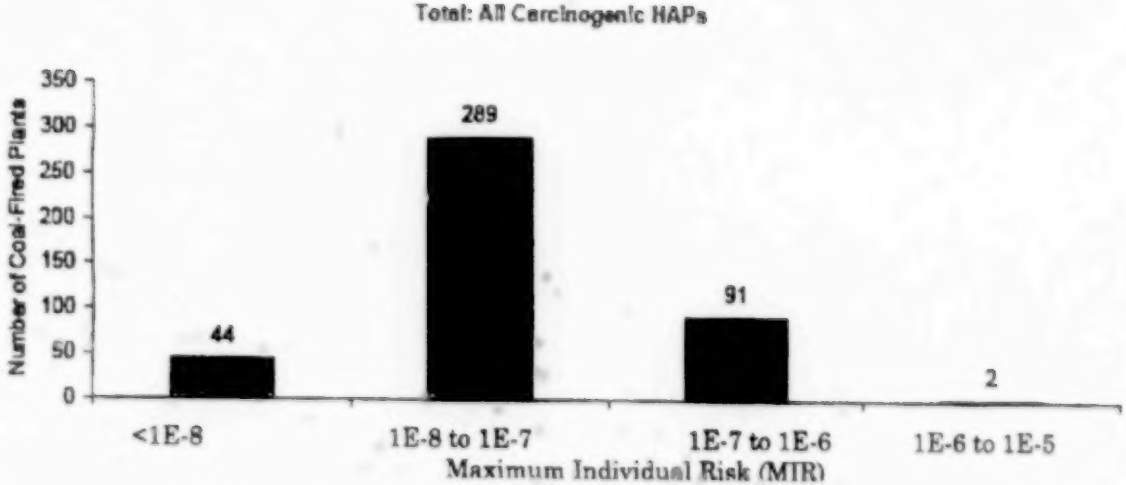


Figure 6-1a. Number of Coal-Fired Utilities Posing Various Levels of Maximum Individual Risk (by levels of MIR)

[Page 6-6]

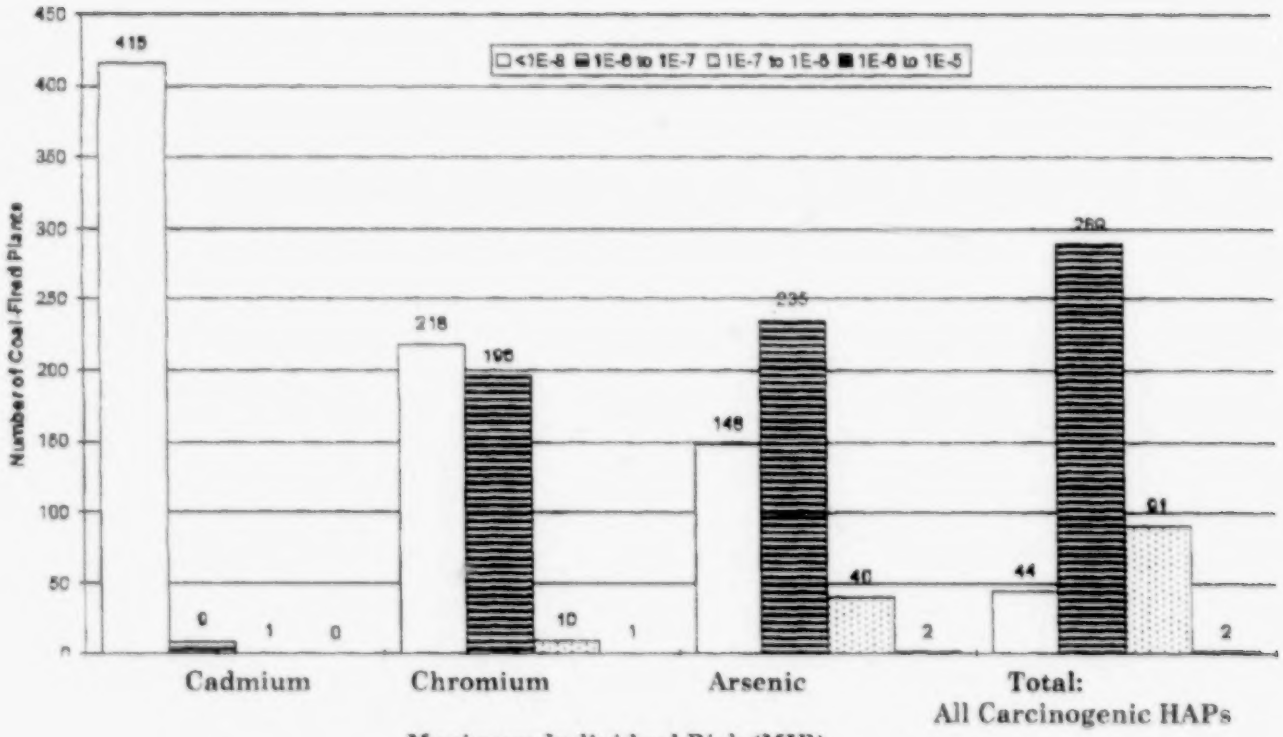


Figure 6-1b. Number of Coal-Fired Utilities Posing Various Levels of Maximum Individual Risk (by levels of MIR)

[Page 6-7]
Table 6-2. Summary of High-End Estimates of Population Exposed at Various Levels of Inhalation Risk or Greater by HAP: Coal- Fired Utilities

Risk level	Arsenic	Chromium	Beryllium	Cadmium	Dioxins/ furans
5×10^{-6}	0	0	0	0	0
2.5×10^{-6}	0	0	0	0	0
1×10^{-6}	852	107	0	0	0
5×10^{-7}	5,990	2,160	0	0	0
2.5×10^{-7}	88,800	8,630	0	0	0
1×10^{-7}	1,710,000	80,500	1,280	107	0

6.1.1.3 Noncancer Risk. The maximum HQ estimated for noncarcinogenic HAPs emitted from coal-fired power plants was 0.1 for HCl. The next highest was 0.05 for manganese. HQ values for all other HAPs were at least an order of magnitude lower. This assessment does not include background concentrations due to other sources.

* * *

[Page 7-8]
Table 7-1. Best Point Estimates of National Mercury Emission Rates by Category

Sources of mercury[a]	1994-1995 Mg/yr[b]	1994-1995 tons/yr[b]	% of Total inventory[b]
Area sources	3.1	3.4	2.2
Lamp breakage	1.4	1.5	1.0
General laboratory use	1.0	1.1	0.7
Dental preparations	0.6	0.7	0.4
Landfills	<0.1	<0.1	0.0
Mobile sources	c	c	c
Paint use	c	c	c
Agricultural burning	c	c	c

Point Sources	140.9	155.7	97.8
Combustion sources	125.2	137.9	86.9
Utility boilers	46.8	51.5	32.6
Coal	(46.7)d	51.3	32.5
Oil	(0.2)	(0.2)	(0.1)
Natural gas	(<0.1)	(<0.1)	(0.0)
MWCs b	26.9	29.6	18.7
Commercial/industrial boilers	25.8	28.4	17.9
Coal	(18.8)	(20.7)	(13.1)
Oil	(7.0)	(7.7)	(4.9)
MWIs b	14.6	16.0	10.1
Hazardous waste combustors e	6.4	7.1	4.4
Residential boilers	3.3	3.6	2.3
Oil	(2.9)	(3.2)	(2.0)
Coal	(0.4)	(0.5)	(0.3)
SSIs	0.9	1.0	0.6
Wood-fired boilers f	0.2	0.2	0.1
Crematories	<0.1	<0.1	0.0
Manufacturing sources	14.4	15.8	10.0
Chlor-alkali	6.5	7.1	4.5
Portland cement e	4.4	4.8	3.1
Pulp and paper manufacturing	1.7	1.9	1.2
Instruments manufacturing	0.5	0.5	0.3
Secondary Hg production	0.4	0.4	0.3
Electrical apparatus	0.3	0.3	0.2
Carbon black	0.3	0.3	0.2
Lime manufacturing	0.1	0.1	0.1
Primary lead	0.1	0.1	0.1
Primary copper	<0.1	<0.1	0.0
Fluorescent lamp recycling	<0.1	<0.1	0.0
Batteries	<0.1	<0.1	0.0
Primary Hg production	c	c	c
Mercury compounds	c	c	c
Byproduct coke	c	c	c
Refineries	c	c	c
Miscellaneous sources	1.3	1.4	0.9
Geothermal power	1.3	1.4	0.9
Turf products	g	g	g
Pigments, oil, etc.	g	g	g
TOTAL	144	158	100

a MWC = Municipal waste combustor; MWI = medical waste incinerator; SSI = sewage sludge incinerator.

b Numbers do not add exactly because of rounding.

c Insufficient information to estimate 1994-1995 emissions.

d Parentheses denote subtotal within larger point source category.

e For the purpose of this inventory, cement kilns that burn hazardous waste for fuel are counted as hazardous waste combustors.

f Includes boilers only; does not include residential wood combustion (wood stoves).

g Mercury has been phased out of use.

h U.S. EPA has finalized emission guidelines for these source categories which will reduce mercury emissions by at least an additional 90 percent over 1995 levels.

* * *

[Page 14-8]

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14.7 AREAS FOR FURTHER RESEARCH AND ANALYSIS

There are numerous uncertainties and data gaps described throughout this report. This section identifies several of the important areas in which further research or scientific and technical work is needed.

14.7.1 Emissions Data for Dioxins

Emissions data for dioxins were available from only eight of the tested utility plants. Therefore, there are greater uncertainties with the dioxin emissions than for many of the other HAPs. All types of utility units were not tested (e.g., there are no data available from coal-fired units with hot-side ESPs).

14.7.2 Speciation of Nickel and Chromium

There are significant uncertainties regarding the forms of nickel being emitted from oil-fired utilities and the health effects associated with those different forms. Therefore, further research and evaluation of the emissions to determine what forms are being emitted and the health effects associated with those different forms would be of value. Further evaluation of chromium speciation is also needed.

14.7.3 Multipathway Risk Assessment

As mentioned previously, further work is needed to study the risks due to multipathway exposure to

HAPs that are persistent and bioaccumulate. Arsenic and dioxins are two HAPs identified as priority for further multipathway assessment.

14.7.4 Long-range Transport Exposures

Uncertainties remain regarding long-range transport of HAPs. Further modeling and evaluation could be helpful to assess the impacts of long-range transport of HAPs from utilities.

14.7.5 Mercury Issues

There are numerous areas regarding mercury that may need further research, study, or evaluation. A number of potential areas for further study include the following:

- review the estimates of the levels of exposure to mercury associated with subtle neurological endpoints;

[Page 14-9]

- quantify and/or evaluate the relationship between a change in United States mercury emissions and the resulting change in methylmercury levels in fish;

- evaluate actual consumption patterns and estimates of the methylmercury exposure of the subpopulations of concern;

- gather additional data on the mercury content of various types of coal;

- establish improved methods for measuring mercury concentrations in water;

- study the occupational, dietary, and behavioral factors that affect mercury exposures for people who are determined to be exposed above a threshold of concern;

- study the public health and environmental benefits that would be expected by reducing mercury emissions from utilities;

- evaluate and/or research control technologies or pollution prevention options that are available, or will be available, that could potentially reduce mercury emissions and what are the costs, economic impacts, and feasibility of those options;

- evaluate how other regulations, programs, and activities (e.g., acid rain program, electricity restructuring, NAAQS, climate change) affect mercury emissions;

- gather additional data on mercury emissions (e.g., how much is emitted from various types of utility units, how much is divalent vs elemental mercury, and how do factors such as control device, fuel type, and plant configuration affect emissions and speciation); and

- study how much mercury is emitted from natural sources and past anthropogenic sources.

14.7.6 Projections to the Year 2010

There are significant uncertainties and unknowns in the emissions and risk projections made to the year 2010 (e.g., impact of industry restructuring; impact of State efforts to regulate restructuring; impact of any climate change

initiatives). Further research and evaluation in this area is needed.

14.7.7 Ecological Risks

The effects of HAPs on wildlife, endangered species, and terrestrial and aquatic ecosystems were not evaluated in this study. Although not mandated by section 112(n)(1)(A), further evaluation of

[Page 14-10]
ecological risks due to HAP emissions would be needed to fully evaluate the impacts of utility HAP emissions.

14.7.8 Criteria Pollutant and Acid Rain Programs

Further evaluation is needed to assess the impacts of the Acid Rain and Criteria Pollutant programs (e.g., impact of revisions to the PM-fine and ozone NAAQS; impact of Ozone Transport Assessment Group [OTAG] activities) on HAP emissions.

14.7.9 Short-term Emissions

A limited assessment of short-term exposures was completed. However, further evaluation of short-term releases, especially highend, peak releases, could be useful to fully assess the potential impacts to public health due to emissions of HAPs (particularly HCl and HF) from utilities.

Federal Register /Vol. 69, No. 20 / Friday, January 30, 2004 / Proposed Rules

[Page 4657]

* * *

C. What Are the Health Effects of HAP Emitted From Coal- and Oil-Fired Utility Units?

Data collected during development of the proposed section 112 rule show that coal- and oil-fired Utility Units emit a wide variety of metal, organic, and inorganic HAP, depending on the type of fuel that is combusted. Today's proposed rules, both under CAA section 111 and 112, would protect air quality and promote the public health by reducing emissions of Hg and Ni from coal- and oil-fired Utility Units. Exposure to Hg and Ni at sufficiently high levels is associated with a variety of adverse health effects. The EPA cannot currently quantify whether, and the extent to which, the adverse health effects occur in the populations surrounding these facilities, and the contribution, if any, of the facilities to those problems. However, to the extent the adverse effects do occur, either of today's proposed actions would reduce emissions and subsequent exposures. Following is a summary of the health effects for the Hg and Ni emissions that would be reduced by either of the proposed rules.

Mercury. Mercury is a persistent, bioaccumulative toxic metal that exists in three forms: elemental Hg (Hg^0), inorganic Hg (Hg^{++}) compounds (primarily mercuric chloride), and organic Hg compounds (primarily methylmercury). Each form exhibits different health effects. Various

major sources may release elemental or inorganic Hg; environmental methylmercury, the form of concern for this rulemaking, is typically formed by biological processes after Hg has precipitated from the air and deposited into water bodies.

Mercury is toxic to humans from both the inhalation and oral exposure routes. In the proposed rulemaking, we focus

[Page 4658]
on oral exposure of methylmercury as it is the route of primary interest for human exposures. Methylmercury is a well-established human neurotoxin although, as with many chemicals, the scientific community is divided on the specific dose and frequency of exposure required to elicit adverse effects. According to the NAS, chronic low-dose prenatal methylmercury exposure has been associated with poor performance on neurobehavioral tests in children, including those tests that measure attention, visual-spacial ability, verbal memory, language ability, fine motor skills, and intelligence. Furthermore, it has been hypothesized that there is an association between methylmercury exposure and an increased risk of coronary disease in adults; however, this hypothesis warrants further study as the few studies currently available present conflicting results. (NEJOM; 2002; Yoshizawa, 2002; Guallar, 2002; Salonen, 1999; Salonen, 1995; Bolger, 2003).

Fish consumption dominates the pathway for human and wildlife exposure to methylmercury. There is a great deal of variability among individuals in fish consumption rates. Critical elements in

estimating methylmercury exposure and risk from fish consumption include the species of fish consumed, the concentrations of methylmercury in the fish, the quantity of fish consumed, and how frequently the fish is consumed. The typical U.S. consumer eating a wide variety of fish from restaurants and grocery stores is not in danger of consuming harmful levels of methylmercury from fish and is not advised to limit fish consumption. Those who regularly and frequently consume large amounts of fish, either marine or freshwater, are more exposed. Because the developing fetus may be the most sensitive to the effects from methylmercury, women of child-bearing age are regarded as the population of greatest interest. The EPA, Food and Drug Administration, and many States have issued fish consumption advisories to inform this population of protective consumption levels.

The EPA's 1997 Mercury Study RTC supports a plausible link between anthropogenic releases of Hg from industrial and combustion sources in the U.S. and methylmercury in fish. However, these fish methylmercury concentrations also result from existing background concentrations of Hg (which may consist of Hg from natural sources, as well as Hg which has been re-emitted from the oceans or soils) and deposition from the global reservoir (which includes Hg emitted by other countries). Given the current scientific understanding of the environmental fate and transport of this element, it is not possible to quantify how much of the methylmercury in fish consumed by the U.S. population is contributed by U.S. emissions relative to other sources of Hg (such as natural sources and

reemissions from the global pool). As a result, the relationship between Hg emission reductions from Utility Units and methylmercury concentrations in fish cannot be calculated in a quantitative manner with confidence. In addition, there is uncertainty regarding over what time period these changes would occur. This is an area of ongoing study.

Given the present understanding of the Hg cycle, the flux of Hg from the atmosphere to land or water at one location is comprised of contributions from: the natural global cycle; the cycle perturbed by human activities; regional sources; and local sources. Recent advances allow for a general understanding of the global Hg cycle and the impact of the anthropogenic sources. It is more difficult to make accurate generalizations of the fluxes on a regional or local scale due to the sitespecific nature of emission and deposition processes. Similarly, it is difficult to quantify how the water deposition of Hg leads to an increase in fish tissue levels. This will vary based on the specific characteristics of the individual lake, stream, or ocean.

As part of routine U.S. population surveillance, the U.S. Centers for Disease Control (CDC) assessed Hg concentrations in blood of over 1,500 women of child-bearing age. A recent analysis of these data reported that about 8 percent of these women of child-bearing age have levels of Hg in their blood that are at or above the U.S. EPA's RfD. The CDC also surveyed the same group of women about their eating habits. The surveyed women reported eating shrimp and tuna more frequently than other fish and shellfish options. Hg concentrations in seafood may

be largely responsible for elevated levels of Hg in U.S. women of child-bearing age. We have little information about how Hg emissions from U.S. power plants may affect Hg concentrations in shrimp, tuna, and other marine fish. We seek comment on this issue and in particular, any data or other information that would allow us to better estimate the extent to which today's proposal would reduce blood Hg concentrations in U.S. women.

Recent estimates (which are highly uncertain) of annual total global Hg emissions from all sources (natural and anthropogenic) are about 5,000 to 5,500 tons per year (tpy). Of this total, about 1,000 tpy are estimated to be natural emissions and about 2,000 tpy are estimated to be contributions through the natural global cycle of re-emissions of Hg associated with past anthropogenic activity. Current anthropogenic emissions account for the remaining 2,000 tpy. Point sources such as fuel combustion; waste incineration; industrial processes; and metal ore roasting, refining, and processing are the largest point source categories on a world-wide basis. Given the global estimates noted above, U.S. anthropogenic Hg emissions are estimated to account for roughly 3 percent of the global total, and U.S. utilities are estimated to account for about 1 percent of total global emissions. (Utility RTC at 7–1 to 7–2.)

Nickel. Nickel is a natural element of the earth's crust; therefore, small amounts are found in food, water, soil and air. Food is the major source of Ni exposure. Ni is an essential element in some animal species. Individuals may also be exposed to Ni if they are employed in occupations involved in Ni

production, processing, and use, or through contact with every day items such as Ni-containing jewelry and stainless steel cooking and eating utensils, and by smoking tobacco. The route of human exposure to Ni that we are concerned with in this rulemaking is Ni that is found in ambient air at very low levels as a result of releases from oil-fired Utility Units. The differing forms of Ni have varying levels of toxicity. There is great uncertainty about the different species of Ni emitted by Utility Units.

Respiratory effects, including a type of asthma specific to Ni, decreased lung function and bronchitis have been reported in humans who have been occupationally exposed to high-levels of Ni in air. Animal studies have reported effects on the lungs and immune system from inhalation exposure to soluble and insoluble Ni compounds (nickel oxide, subsulfide, sulfate heptahydrate). Soluble Ni compounds are more toxic to the respiratory tract than less soluble compounds. The EPA has not established a reference concentration (RfC)for Ni. No information is available regarding the reproductive or developmental effects of Ni in humans, but animal studies have reported such effects, although a consistent doseresponse relationship has not been seen. Human and animal studies have reported an increased risk of lung and nasal cancers from exposure to Ni refinery dusts and Ni subsulfide. The EPA has classified Ni carbonyl as a Group B2, probable human carcinogen based on lung tumors in animals. (*see*

[Page 4659]
http://www.epa.gov/ttn/atw/hlthef/ nickel.html).

We ask for comment on all aspects of our proposed revised determination that it is necessary and appropriate to regulate Ni emissions from oil-fired Utility Units under section 112. In particular, we ask for comments and additional information related to the speciation of Ni compounds directly emitted by oil-fired Utility Units and those that may be formed through atmospheric transformation, as well as information on potential health effects. We also ask commenters—especially current owners and operators of potentially affected oil-fired units—to provide information on the current operating status and anticipated mode of operation in the future of potentially affected oil-fired Utility Units, including current control technology. To the extent possible, we would like to have up-to-date information on fuel use, emissions, stack parameters and other location-specific data that would be relevant to the assessment of emissions, dispersion, and ambient air quality. We also ask for comment on our finding in the Utility RTC that only 11 of 137 oilfired Utility Units considered in the Utility RTC posed an inhalation risk to human health greater than one in a million (1×10^{-6}) and whether data exists as to whether emissions from these plants no longer pose such risk.

Federal Register /Vol. 70, No. 59 /Tuesday, March 29, 2005 /Rules and Regulations

[Page 16019]

* * *

F. Fish Tissue Levels of Methylmercury Modeled To Result After Implementation of CAIR and CAMR

This section describes the amounts of Utility Unit attributable Hg deposition onto watersheds (termed HUC), as well as the Utility-attributable methylmercury in fish tissue, all under the various control scenarios modeled.

1. Utility-Attributable Hg Deposition Patterns

The air quality modeling shows that total Hg deposition is not highly impacted by utility deposition. The small size of this impact is evident when utility emissions are, in effect, zeroed out in the 2001 base case. The following tables summarize impacts on total Hg deposition and Hg deposition attributable to Utility Units.

[Page 16019 cont.]

TABLE VI–4.—SUMMARY STATISTICS FOR TOTAL HG DEPOSITION
[Aggregated to the HUC–8 level]

	2001 Base case	2001 Utility zero out	2020 Base case (with CAIR)	2020 Utility zero out	2020 CAMR requirements	2020 CAMR alternative
Minimum	6.94	6.94	6.08	5.90	6.08	6.07
Maximum	54.54	54.38	62.76	62.72	62.76	62.75
50th percentile	15.92	14.60	14.59	13.92	14.44	14.39
90th percentile	22.16	19.48	19.46	19.04	19.37	19.33
99th percentile	32.35	27.20	29.15	28.93	28.96	28.95

(All units are expressed in micrograms per square meters.)

TABLE VI–5. SUMMARY STATISTICS FOR UTILITY ATTRIBUTABLE HG DEPOSITION
[aggregated to the HUC–8 level]

	2001 Base case	2020 Base case (with CAMR)	2020 CAMR Requirements	2020 CAMR Alternative
Minimum	0.00	0.00	0.00	0.00
Maximum	19.71	4.03	3.85	3.80
50th percentile	0.39	0.3	10.26	0.22
90th percentile	4.08	1.38	1.16	0.99
99th percentile	10.15	2.56	2.17	2.04

(All units are expressed in micrograms per square meters.)

[Page 16019 cont.]

The median deposition level is reduced by only 8 percent when utilities emissions are zeroed out in 2001, suggesting that utilities are not a major source of Hg deposition in most HUCs. Even so, at HUCs with the highest deposition levels, zeroing out utilities reduces the 99th percentile deposition level by 16 percent, suggesting that there are relatively larger impacts of utilities in high deposition areas.

By 2020, after implementation of CAIR, significant reductions in deposition attributable to utilities occurs. HUCs with high levels of utility deposition receive a larger reduction in Utility-attributable Hg deposition relative to HUCs with a relatively small level of Utility-attributable deposition. Specifically, CAIR results in a 75 percent reduction in the 99th percentile of Utility-attributable deposition, and a 20 percent reduction in the 50th percentile. CAIR also shifts the distribution of utility-attributable deposition. In the 2001 base case, 10 percent of HUCs had greater than 20 percent of deposition attributable to utilities. In the 2020 post-CAIR base case, no HUCs had greater than 20 percent of deposition attributable to utilities, and 90 percent had less than 9 percent of deposition attributable to utilities.

[Page 16020]

Additional reductions in Hg emissions due to the CAMR requirements result in relatively small additional shifts in the distribution of deposition. Additional emissions reductions due to the CAMR requirements result in a small additional reduction in the number of HUCs with a high percentage of

utilityattributable emissions. (The incremental impact of the CAMR alternative relative to the promulgated CAMR requirements is very small.)

2. EGU-Attributable Methylmercury Fish Tissue Levels

The following tables summarize the methylmercury fish tissue levels associated with the various Utility Unit Hg emissions scenarios. All units refer to mg (of methylmercury) per kg (fish tissue), or parts per million (ppm). As a frame of reference, it should be noted that EPA's default water quality criterion is 0.3 mg/kg.

[Page 16020 cont.] TABLE VI—6. SUMMARY STATISTICS FOR TOTAL FISH TISSUE METHYLMERCURY

[Sample locations]

	2001 Base case	2001 Utility zero out	2020 Base case CAIR	2020 Zero out	2020 CAMR requirements	2020 CAMR alternative
Minimum	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	4.49	3.64	3.65	3.46	3.63	3.61
50th percentile	0.25	0.21	0.21	0.20	0.21	0.21
90th percentile	0.90	0.81	0.79	0.77	0.79	0.78
99th percentile	1.80	1.65	1.64	1.57	1.63	1.63

(All units are in mg methylmercury per kg fish tissue.)

TABLE VI—7. SUMMARY STATISTICS FOR UTILITY ATTRIBUTABLE FISH TISSUE METHYLMERCURY

[Across sampling locations]

	2001 Base	2020 (with CAIR)	2020 CAMR Requirements	2020 CAMR Alternative
Minimum	0.00	0.00	0.00	0.00
Maximum	0.85	0.25	0.19	0.18
50th percentile	0.03	0.01	0.01	0.01
90th percentile	0.11	0.03	0.03	0.03
99th percentile	0.26	0.10	0.09	0.08

(All units are in mg methylmercury per kg fish tissue.)

a. 2001 Base case and 2001 Utility Zero-out. In the 2001 base case, as a result of all international and U.S. emissions, and before U.S. utilities implement reductions from CAIR or CAMR, the 50th percentile of the sample points had an estimated methylmercury fish tissue concentration of 0.25 mg/kg. The 90th percentile water body had an estimated methylmercury fish tissue concentration of 0.90 mg/kg, and the 99th percentile had 1.80 mg/kg.

The amount of methylmercury attributable solely to utilities in the 2001 base case, which becomes evident when utilities are zeroed out, is of course much smaller. The 50th percentile of the sample points had an estimated methylmercury fish tissue concentration. attributable solely to utilities, of 0.03 mg/kg. The 90th percentile had 0.11 mg/kg, the 99th percentile had 0.26 mg/kg, and the maximum individual sample point had 0.85 mg/kg.

It should be recalled that EPA recommends the water quality criterion of 0.3 mg/kg as a level that, given fish consumption at the 90th percentile level, would result in exposure levels below the RfD. For present purposes, EPA does not consider the water quality criterion of 0.3 mg/kg as a bright-line test for evaluating fish tissue methylmercury levels attributable to U.S. Utility Units. Rather, the criterion serves as establishing a broad frame of reference, that serves to place into context both the overall methylmercury fish tissue levels (which are attributable to methylmercury from all sources) and the methylmercury levels attributable to Utility Units.

These results indicate the relatively small percentage of U.S. utility contribution to U.S. fish tissue methylmercury levels.

b. 2020: Utilities With CAIR Reductions. EPA's modeling shows that in 2020, as a result of all international and U.S. emissions, and with U.S. utilities implementing reductions from CAIR (but not CAMR), the 50th percentile of the sample points is projected to have a methylmercury fish tissue concentration of 0.21 mg/kg. The 90th percentile is projected to have 0.79 mg/kg, and the 99th percentile is projected to have 1.64 mg/kg.

The amount of methylmercury in fish attributable solely to utilities in 2020, after implementation of the CAIR reductions (but, again, before CAMR), of course is smaller. The 50th percentile of the sample points is projected to have fish tissue concentration, attributable solely to utilities of 0.01 mg/kg. The 90th percentile is projected to have 0.03 mg/kg, the 99th percentile is projected to have 0.10 mg/kg, and the maximum individual sample point (*i.e.*, the one with the highest methylmercury levels) is projected to have 0.25 mg/kg.

Again, using the 0.3 mg/kg methylmercury water quality criterion as a broad frame of reference serving to place in context both the overall methylmercury fish tissue levels (attributable to methylmercury from all sources) and the methylmercury fish tissue levels attributable to Utility Units, it is clear that the latter levels, following implementation of CAIR, are low.

c. 2020: Utilities with CAMR Controls. The CAMR level of controls achieve further, albeit small, reductions in methylmercury fish tissue concentrations. Compared to the CAIR controls, the CAMR controls would further reduce, in 2020, methylmercury fish tissue concentrations by, in the 99th percentile, 0.01 mg/kg.

d. 2020: Utilities with Alternative CAMR Controls. EPA evaluated, but did not adopt, a slightly tighter level of CAMR controls. These alternative

[Page 16021]
CAMR controls would have achieved still further, albeit, again small, reductions in Hg deposition and in fish tissue methylmercury levels. Compared to the CAIR controls, these alternative CAMR controls would reduce methylmercury fish tissue levels in 2020 by, in the 99th percentile, 0.02 mg/kg.[49]

5. Overall Impact of CAIR and CAMR Controls on Utility Unit Hg Emissions

As described in the CAIR rule, CAIR reduces EGU Hg emissions from pre- CAIR levels by a substantial percentage. CAMR reduces Utility Unit Hg emissions, from CAIR levels, by 27 percent. CAMR reduces ionic Hg emissions, those that are most likely to result in local and regional deposition, by 17 percent relative to CAIR levels.

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[49] A detailed discussion of the control alternatives we considered and the reason for our final selection is contained in the preamble to the final CAMR.

These reductions tend to occur from the largest sources. That is, the larger the source of Hg emissions, the more likely it is to implement CAIR or CAMR controls, and therefore the more likely it is to reduce its Hg emissions. More specifically, under the cap-and-trade system, the marketplace tends to direct controls to the largest emitters because those emitters can achieve the most cost-effective reductions. Compared to smaller emitters, these larger emitters have an incentive to implement more stringent controls, thereby reducing their emissions further below the level of their allowances, and thereby generating a larger number of allowances for sale to defray control costs. See "Proposed National Emissions Standards for Hazardous Air Pollutants; and in the Alternative, Proposed Standards of Performance for New and Existing Sources: Electric Utility Steam Generating Units," 9 FR 4652, 4702–03 (Jan. 30, 2004).

G. Exposure to Utility-Attributable Methylmercury Levels in Fish Tissue

CAIR reduces median Utilityattributable fish tissue methylmercury levels, from pre-CAIR levels, by 67 percent. CAIR reduces the 99th percentile Utility-attributable fish tissue methylmercury levels, from pre-CAIR levels, by 60 percent. CAMR reduces median Utility-attributable fish tissue methylmercury levels, from CAIR levels, by 12 percent. CAMR reduces the 99th percentile Utility-attributable fish tissue methylmercury levels, from CAIR levels, by 9 percent.

As a result of these reductions, after CAIR or CAMR, no sample site remains in which Utility-

attributable, emissions cause methylmercury fish tissue levels to exceed 0.3 mg/kg (EPA's water quality criterion).

Even with these reductions, although the levels of methylmercury in fish tissues attributable to Utility Units are small, the magnitude of methylmercury exposure depends on consumption levels and the sensitivity of the individual. For purposes of assessing whether utility Hg emissions are reasonably anticipated to result in hazards to public health, we focused on evaluating utility attributable methylmercury exposures for women of childbearing age in the general U.S. population who consume noncommercial (*e.g.*, recreational) freshwater fish in U.S. waterbodies.

This section describes available information as to the consumption levels of women of child-bearing age within the population of recreational fishers who consume at typical levels, and within high-consumption subpopulations; and discusses the amounts of methylmercury that may be ingested as a result of those consumption levels.

1. General Population

We believe that only those women of childbearing age who consume noncommercially caught U.S. freshwater fish have the potential for significant exposures to utilityattributable methylmercury. As a result, our assessment of the hazards to public health focuses on those women.

2. Recreational Fishers Who Consume Fish At Typical Levels.

a. Consumption Levels. For our analysis of recreational freshwater fish consumption, EPA has determined that the sport-caught fish consumption rates for recreational freshwater fishers specified as "recommended" in the EPA's Exposure Factors Handbook (mean of 8 gm/day and 95th percentile of 25 gm/day), represent the most appropriate values for present purposes. These recommended values were derived based on ingestion rates from four studies conducted in Maine, Michigan, and Lake Ontario (Ebert *et al.*, 1992; Connelly *et al.*, 1996; West *et al.*, 1989; West *et al.*, 1993). These studies are suitable because they included information for annual-averaged daily intake rates for self-caught freshwater fish by all recreational fishers including consumers and non-consumers. The mean values presented in these four studies ranged from 5 to 17 gm/day, while the 95th percentile values ranged from 13 to 39 gm/day.[50]

The EPA "recommended values" were developed by considering the range and spread of means and 95th percent values presented in the four studies. EPA recognizes that use of mean and 95th percentile consumption rates based on these four studies may not be representative of fishing behavior in every state and that there may be regional trends in consumption that differ from the values used in this analysis. However, EPA believes that these four

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[50] The 39 gm/day value actually represents a 96th percentile value.

studies represent the best available data for developing recreational fisher ingestion rates for present purposes.

As a result, for today's purposes of evaluating the potential for health effects for consumers of recreational freshwater fish resulting from exposure to utility-attributable methylmercury, we consider both the mean of 8 gm/day consumption and the 95th percentile amount of 25 gm/day.

b. Levels of Consumption Combined with Levels of Utility-Attributable Methylmercury in Fish Tissue. As described above, fish tissue levels of Utility-attributable methylmercury, for virtually all sample points, are only a fraction of the 0.3 mg/kg (fish tissue) water quality criterion. EPA evaluated recreational fish consumers' exposure to this Utility-Attributable methylmercury by calculating the level of exposure to this methylmercury and comparing it to the RfD when background exposures are not considered. For the purposes of assessing population exposure due solely to power plants, we create an index of daily intake (IDI).The IDI is defined as the ratio of exposure due solely to power plants to an exposure of 0.1 µug/kg bw/day. The IDI is defined so that an IDI of 1 is equal to an incremental exposure equal to the RfD level, recognizing that the RfD is an absolute level, while the IDI is based on incremental exposure without regard to absolute levels. Note that an IDI value of 1 would represent an absolute exposure greater than the RfD when background exposures are considered.

At either the mean fish consumption rate of 8 gm/day or the 95th percentile fish consumption rate

of 25 gm/day for recreational fish consumers discussed above, and using the 99th percentile methylmercury fish tissue concentration attributable to Utility Unit (and a typical body weight of 64 kg for women of child-bearing age), the calculated Utility-attributable methylmercury exposures are 0.013 µug/kg body weight per day and 0.04 µug/kg body weight per day, respectively. Both calculated exposures are well below the RfD of 0.1 µug/kg body weight per day (an IDI value well below 1).

[Page 16022]

EPA uses the RfD to place ingestion levels in context. The RfD level of methylmercury ingestion—0.1 µug/kg body weight—should not be considered a bright line standard above which adverse health effects occur, but rather as an aid in establishing the context for evaluating both overall methylmercury ingestion (arising from methylmercury from all sources) as well as Utility- Attributable methylmercury ingestion in light of consumption rates. Our analysis concludes that Utility Unit Hg emissions do not cause hazards to the health of the general public or higher fish consuming recreational anglers.

3. High-Level Fish Consumption Sub- Populations

Although exposure to Utilityattributable methylmercury from freshwater fish tissue is quite low for recreational fishers generally, as just described, EPA recognizes that certain sub-populations consume higher levels of U.S. freshwater fish. These populations may include a subset of recreational fishers who consume large quantities of fish, individuals who are subsistence fishers, and

individuals who are part of certain ethnic groups. EPA is aware that at very high consumption levels, even relatively small concentrations of methylmercury in fish may result in exposures that exceed the RfD.

However, as described in the TSD, characterization of fish consumption rates for the highest fish consuming subpopulations (*e.g.*, Native American and other ethnic populations exhibiting subsistence-like consumption) in the context of a larger regional or national analysis is technically challenging. Peer reviewed study data on these populations is relatively limited, especially when subjected to the criteria outlined in the TSD. Many of the high consumption groups that have been studied are located near the ocean and consequently have a significant fraction of their overall exposure comprised of saltwater fish. In addition, some of these studies provide details on seasonal consumption rates, but do not integrate these rates to provide an overall mean annual-averaged consumption rate relevant to an RfD-based analysis.

Although many of these studies provide mean consumption rates, few have identified specific high-end percentile values (*e.g.*, 90th, 95th or 99th percentile consumption rates). Instead, many studies, including a number of non-peer reviewed sources, cite non-specific high-end or bounding point estimates (*e.g.*, the range of consumption rates for the Ojibwe submitted for the CAMR NODA). While these point values can be used in developing high-end bounding scenarios for evaluating risk to these groups, they do not support populationlevel analysis

of exposure since they cannot be used to fit distributions characterizing variability in fish consumption rates across these subpopulations (as noted above, modeling of population-level exposures requires that distributions characterizing fish consumption rates across a particular population be developed).

An additional challenge in characterizing high-level fish consumption is that care needs to be taken in extrapolating study results from one group to another. This reflects the fact that high-level fish consumption is often tied to socio-cultural practices and consequently consumption rates for a study population cannot be easily transferred to other groups which may have different practices (*e.g.*, practices for one Native American tribe may not be relevant to another and consequently behavior regarding fish consumption may not be generalized).

Despite these challenges in characterizing high-level consumption, EPA has developed recommended subsistence-level fish consumption rates of 60 g/day (mean) and 170 g/day (95th percentile) (EPA, 1997, Exposure Factors Handbook). These values are based on a study of several Native American Tribes located along the Columbia River in Washington State. Although these consumption rates are specific to the tribes included in the study and reflect their particular sociocultural practices (including seasonality and target fish species), EPA believes that this study does provide a reasonable characterization of highconsuming subsistence-like freshwater fishing behavior (EPA, 1997, Exposure Factors Handbook). Therefore, in the absence of data

on local practices, EPA recommends that these consumption rates be used to model high-consuming groups in other locations. It is important to note that, as explained above, application of these subsistence consumption rates outside of the original Columbia River study area could be problematic because it would be difficult to transfer these consumption rates to a different group that might exhibit different fishing behavior. However, these recommended rates can be used to model subsistence scenarios at different locations.

Although these subsistence consumption rates are recommended by EPA, commenters (including NODA comments obtained for this rule), have identified alternative consumption rates for specific high consuming groups that are in some instances, higher than these recommended values. For example, a survey by the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) (as referenced in comments to the CAMR NODA) indicates that consumption rates by members of Ojibwe Great Lakes tribes during fall spearing season may range from 155.8–240.7 g/day and may range from 189.6–292.8 g/day during the spring. EPA has reviewed these comments and does not believe that it would be appropriate to rely on them for purposes this rulemaking. First, the data has not been peer reviewed. Moreover, it is not clear from the comments how many people consume fish at those rates, to what extent those fish consumers are

women of childbearing years, and how to annualize these seasonal sales.[51]

For all the above reasons, and despite comments indicating that some subgroups may have larger short-term consumption rates, EPA believes that the Columbia River-based consumption rates of between 60 g/day (mean) and 170 g/day (95th percentile) are appropriate default values for subsistence fish consumers.

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[51] As discussed below, the Ojibwe Great Lakes tribes do not appear to be located in areas with high utility-attributable Hg deposition.

Technical Support Document (TSD)
for the Transport Rule
Docket ID No. EPA-HQ-OAR-2009-0234

Coal-to-Gas Conversion (C2G)

U.S. Environmental Protection Agency
Office of Air and Radiation
March 4, 2011

Coal-to-Gas Conversions (C2G)

Section V in the preamble to the Toxics Rule discusses coal-to-gas conversion (C2G) as a retrofit technology option to reduce air pollutant emissions. C2G is provided as a retrofit option to all coal boilers larger than 25 MW in EPA's IPM modeling of the Toxics Rule. This retrofit option is comprehensively modeled with explicit retrofit capital and O&M costs, pipeline extension costs, and heat rate penalties. As mentioned in the preamble, the C2G option was not selected in IPM as an economic choice for coal boilers to comply with the Toxics Rule. This TSD provides a brief explanation of the main reasons why C2G was not an economic choice.

The Toxics Rule requires all EGU coal boilers larger than 25 MW to achieve significant reductions in mercury, HCl, and total PM emissions. In addition to the C2G conversion option, there are other retrofit options available in IPM to reduce these emissions. They include activated carbon injection (ACI), flue gas desulfurization (FGD), and dry alkali sorbent injection (DSI), any of which can individually or in combination make a significant reduction in such emissions.

Table 1 shows the calculated cost-of-electricity (COE) based on characteristics of a representative actual "model plant" in the Proposed Toxics Rule policy modeling. The model plant represents a 303 MW existing coal unit. The performance and incremental costs of the various retrofit options are based on the parameters of actual retrofits offered to such a unit in the IPM model.

Table 1 – Incremental cost-of-electricity for retrofit options on a typical model plant

		Retrofit Options			
	Base Unit	DSI	Dry FGD	ACI	C2G
Unit size (MW)	303	303	303	303	303
Heat Rate (Btu/kWh)	10,502	10,539	10,656	10,506	11,027
Capital Cost of Retrofit ($/kW) including pipeline		47	507	11	323
Fixed O&M of Retrofit ($/kW)		0.8	8.5	0.0	-8.9
Variable O&M of Retrofit ($/kW)		4.49	1.48	1.83	-0.33
Capital Charge Rate (%)		11.3%	11.3%	11.3%	11.3%
Capacity Factor (%)	80%	80%	80%	80%	80%
Fuel	Coal	Coal	Coal	Coal	Gas
Fuel Price ($/MMBtu)	2.13	2.13	2.13	2.13	5.74
Incremental Fixed Costs (mills/kWh)		0.9	9.4	0.2	3.9
Incremental Variable O&M Costs (mills/kWh)		4.5	1.5	1.8	(0.3)
Base and Incremental Fuel Costs (mills/kWh)	22.4	0.1	0.3	0.0	40.9
Total Incremental Cost-of-Electricity (mills/kWh)	Base	5.4	11.2	2.0	44.5

Note that while the combined capital cost and O&M costs for a C2G retrofit could be less than that of a combined retrofit with ACI and either DSI or FGD, the greatly increased fuel costs of C2G cause its total incremental COE ($44.5/MWh) to be between 4 to 22 times the COE impact of the other retrofit options available. The C2G option for this case is therefore uneconomic under the relative fuel cost projections in IPM modeling of the Toxics Rule.

The COE comparison allows consideration of the relative cost-effectiveness of using C2G to obtain beyond-the-floor reductions in the emission rates of toxic air pollutants. For example, DSI is assumed to achieve 90% reduction of HCl in the Toxics Rule modeling, whereas switching the boiler to gas-fired generation would effectively reduce 100% of previous HCl emissions. Therefore, for each 100 tons of uncontrolled HCl emissions, DSI would capture 90 while C2G would increase that capture further by 10 tons, which is about an 11% increase in capture – however, the COE impact increases by 724%. For a similar comparison on mercury, ACI is assumed to capture 90% while C2G would effectively capture 100%, and this 11% increase in capture would be coupled with a 2,125% increase in that unit's COE impact.

For these reasons, EPA does not believe it is cost-effective to require beyond-the-floor emission reductions from coal-to-gas fuel switching in the Toxics Rule.

Date: March 14, 2011

Subject: National Emission Standards for Hazardous Air Pollutants (NESHAP) Beyond the Maximum Achievable Control Technology (MACT) Floor Analysis for Coal- and Oil-fired Electric Utility Steam Generating EGUs

From: Shelly Johnson, Stephen Boone

To: Bill Maxwell OAQPS/SPPD/ESG (D243-01) U.S. Environmental Protection Agency Research Triangle Park, NC 27711

Introduction

The purpose of this memorandum is to present the data and methodology used and the results of a beyond-the-floor (BTF) option analysis for the NESHAP source category "Coal- and Oil-fired Electric Utility Steam Generating Units" (referred to in this memorandum as "EGUs"). For the MACT floor analysis, the EPA defined five EGU subcategories. This memorandum presents the estimates of the incremental pollutant emission reduction and cost that would be achieved by implementing a BTF option to control mercury (Hg) emissions from existing sources in the MACT Analysis Subcategory 2. Subcategory 2 is defined to include new and existing EGUs designed to burn a virgin nonagglomerating coal having a calorific value (determined on moisture and mineral matter-free basis) of less than 8,300 Btu/lb in an EGU with a furnace height-to-depth ratio of 3.82 or greater. The Hg emissions limit established as the MACT Floor

for Subcategory 2 is 11.0 pounds Hg per trillion British thermal EGUs (lbs/TBtu).

The MACT floor analysis uses data collected in a nationwide survey of EGU owners and operators conducted by EPA in 2010 under the *Information Collection Request For National Emission Standards For Hazardous Air Pollutants (NESHAP) for Coal- And Oil-Fired Electric Utility Steam Generating Units* (OMB Control No. 2060-0631). Individual EGU operating and air emissions data reported by respondents to the Information Collection Request (ICR) were compiled into a Microsoft Access software data base that serves as the data set used for this BTF option analysis (referred to in this memorandum as the "ICR data set").

BTF Option Emission Limit Selection

The EPA selected a limit of 4.0 lbs Hg/TBtu for the BTF option. This Hg limit is equivalent to the level of emissions required under CAAA Section 112(d)(3) for new or reconstructed Subcategory 2 units. Hg emissions data compiled from the ICR data set indicates that this BTF option limit is equivalent to the emission level achieved in practice (including emissions variability) by the best controlled similar source. The best controlled unit in Subcategory 2 is equipped with activated carbon injection (ACI) and a fabric filter (FF). This cost analysis assumes that all units within this subcategory will require capital investments in fabric filters that are attributable to the proposed MACT standard for PM (as a surrogate for non- Hg metallic HAP). This analysis determines the marginal capital costs attributable to the BTF

option requiring installation of ACI systems to reduce Hg emissions to 4.0 lbs per trillion Btu.

BTF Option Analysis Methodology

All data used to estimate the costs that would be incurred by the thirty EGUs within *Subcategory 2* came from the data obtained from the ICR data set. The data were analyzed in the following steps:

Step 1 – Estimated current actual annual Hg emission rates for each existing EGU in Subcategory 2. Subsequently, the annual emissions reductions necessary to achieve the MACT floor Hg emissions limit and the BTF option Hg emissions limit were calculated for each of these EGUs.

Step 2 – Identified the Hg emissions control technologies already in place for each EGU using the ICR data set.

Step 3 – Determined annualized capital and operating costs for ACI controls from the ICR data set.

Step 4 – Evaluated the ACI control components that would need to be added to each EGU to meet the MACT floor Hg emission limit.

Step 5 – Evaluated the additional ACI control components that would need to be added to each EGU to meet the BTF option Hg emission limit.

Step 6 – Calculated the incremental difference between the total Hg emissions reduction and

control cost for all existing EGUs in the subcategory to achieve the BTF option Hg emissions limit compared to the MACT floor Hg emissions limit.

BTF Option Hg Emissions Estimates

In order to determine the emissions reductions from the EGUs in Subcategory 2, each EGU's current annual Hg emissions were compared to the EGU's emissions at the MACT floor level and at the BTF option level. For each EGU, an emission factor (lb Hg/TBtu) was assigned based on EGU-specific stack test data from the ICR or from stack test data from the most similar EGU(s). The emission factor assigned to each EGU was either the EGU's provided emission factor or an estimate of the EGU's emission factor based on the fuel fired, the boiler type and the boiler's control scheme. This emission factor was used to calculate the EGU's actual annual pounds of Hg emissions. The calculation also included the EGU's heat input capacity (MMBtu/hr) and the EGU's average capacity factor for the last 3 years.

Once each EGU's current annual Hg emissions were calculated, the annual Hg emission levels at the MACT floor and BTF option were calculated for each EGU based on the same EGU specific data. Subsequently, the annual Hg reductions between current rates and MACT floor were calculated and those between the MACT floor and the BTF option were calculated.

For this analysis it is assumed that an ACI control system consists of the use of the activated carbon injectors and delivery system in conjunction

with a fabric filter (FF). The analysis assumed that if the EGU has other particulate matter (PM) controls in place (i.e. a coldside electrostatic precipitator) a new FF would need to be installed at the facility to comply with the non-Hg metallic HAP standard for PM. Therefore, each EGU was evaluated to determine if the EGU had ACI or FF controls. The Hg emissions control scenarios of importance for this analysis were as follows:

1. EGU with ACI and FF (ACI + FF)

2. EGU with ACI (ACI)

3. EGU with FF (FF)

4. EGU with neither control (none)

Each EGU within Subcategory 2 was classified into one of the four Hg emissions control scenarios. The necessary installation of additional controls for an EGU was dependent on the EGU's current Hg emissions and the current controls. For EGUs already equipped with ACI + FF, no additional capital costs for controls were included in the cost estimate, and the cost of any additional Hg removal necessary to meet the Hg MACT floor or the BTF option was calculated based on additional ACI operating costs. For the EGUs currently with only ACI, FF installation and operating costs were attributed to the MACT floor for non-Hg metallic HAP and the BTF option costs were also calculated based on additional ACI operating costs. For EGUs currently equipped only with FF, ACI capital and operating costs were included in the cost estimate for each MACT emissions level. Similarly, the cost BTF

option cost estimate for EGUs currently with neither control included ACI capital and operating costs with the cost of the FF attributed to the non-Hg metallic HAP MACT standard.

BTF Option Control Cost Estimates

The ACI control cost values were calculated from cost information (provided by facilities currently operating ACI systems) in the EGU ICR data set. In order to calculate the cost of the BTF option, an operating cost was determined based on the amount of Hg removed, and a capital cost based on EGU size was determined. Overall, the ICR data set contains 122 EGUs for which any cost data on ACI controls were reported. These EGUs were filtered to include a total of 16 EGUs that provided capital and operating costs and sufficient Hg emissions data to determine the Hg removal attributable to the project. Of these 16 EGUs, only one EGU was within the Subcategory 2.

For this analysis, all 16 EGUs were used to determine capital costs. It was assumed that the capital cost for each control system was independent of the amount of Hg removed. Each of these capital costs was determined on a heat-input-capacity basis to take into account the equipment for larger EGUs and controls being more costly. Each EGU's control system capital cost was converted from the reported base year dollars to July 2010 dollars using the applicable Chemical Engineering Plant Cost Index (CEPCI) factors. Then, each cost was annualized by applying the capital recovery factor (CRF). The assumed interest rate was 7% and the assumed

period was 20 years. The CRF value used for the analysis is presented in

Table 1. The remaining capital cost value applied was annualized dollars per heat-inputcapacity in million British thermal units per hour ($/MMBtu/hr). The values for each EGU's cost were averaged for the control scenario. Since no EGU provided capital cost data for a FF only, the capital cost for an ACI was subtracted from the capital cost for an ACI and FF.

The operating cost was determined solely from the lignite facility. Since the initial Hg content differs greatly between lignite and subbituminous fuels and the operating cost is based on Hg removed, it was not assumed that the data from the two fuel types could be integrated. The operating cost was calculated on a basis of pounds of Hg removed. This was calculated using the final emission factor achieved and the percent reduction. The amount of Hg removed was calculated taking into account the EGU's capacity factor and heat input. Then, the operating cost, which was provided on an annual basis, was converted to July 2010 dollar values using the CEPCI factors. To calculate cost per pound of Hg removed, the annual operating cost was divided by the pounds of Hg removed ($/lb Hg removed) reflecting the differences between the current Hg emission rate and the MACT floor.

BTF Option Analysis

In order to determine the marginal costs and impacts for the BTF option Hg emissions limit, a cost was first calculated for the subcategory to achieve the MACT floor level. Then, an incremental cost was

calculated for the subcategory to reduce emissions from the MACT floor level to the BTF option limit. If any EGU did not meet the MACT floor, the capital cost for the installation of any control equipment the EGU did not already have was associated with reaching MACT floor. In addition, the operating costs to get the EGU from the current emission rate to the MACT floor was multiplied by the additional pounds of Hg to be removed.

For the marginal cost to get to the BTF limit, the EGU was assumed to have all controls necessary for the EGU to achieve the MACT. For example, if an EGU was above the MACT floor and had to install ACI to meet the Hg MACT floor, then for the BTF Hg option, only ACI operating costs (to reduce emissions from the Hg MACT floor to the BTF limit) would be considered. However, if an EGU with just a FF met the MACT floor, but not the BTF option limit, the methodology assumed that the EGU would have to incur costs to install ACI and the operating costs to reach the BTF option limit. The current controls and additional controls for MACT and BTF are displayed on Table 5.

Using this methodology, the unit-specific analyses were completed to determine additional controls and operating measures, Hg emission reductions, and the associated capital and operating costs. The estimated cost for each EGU was determined, and then the Hg reductions and total costs were summed for MACT and the increment to the BTF limit.

The capital costs are summarized in

Table 2. The annualized capital cost for an ACI system was $108 per MMBtu/hr of heat input capacity. The annualized operating cost was determined to be $14,867 per pound of Hg removed, as shown in Table 3.

The specific EGU costs for MACT floor and the BTF option are shown in Table 5. Of the 30 EGUs, all units met the MACT floor emission level. Of the 30 EGUs, two EGUs would meet the BTF option limit without any additional controls. Taking into account the controls to be added to the EGUs for MACT compliance, 18 EGUs are expected to add FF to comply with the non-Hg metallic HAP standard, 20 EGUs are expected to add ACI, and 3 EGUs are expected to incur increased operating costs associated with the additional activated carbon usage required to achieve the BTF limit.

Energy impacts on Subcategory 2 due to increased auxiliary loads on induced draft (ID) fans and other electrical loads associated with installation of the fabric filter are attributed to the non-Hg metallic HAP standard. The total energy costs for Subcategory 2 were estimated based solely on the relatively low auxiliary loads from activated carbon injection systems and the associated cost data for nominally rated 500 MW units using EPA's Coal Utility Environmental Cost (CUECost) Model for sorbent injection. The total annual costs of energy usage for operation of ACI were estimated as $2,300 per year.

Non-air quality environmental impacts were estimated based on the requirement to dispose of spent activated carbon in landfills. The analysis assumed that this material could be disposed of with the combustion by products as non-hazardous waste. The cost per ton of carbon disposed was estimated at $2/ton based on information in the CueCost Model, and the carbon usage per mass of Hg removed was estimated based on information published by the Center for Air Toxic Metals at the University of North Dakota Energy & Environmental Research Center (EERC). The total costs of the non-air environmental impacts for Subcategory 2 were estimated as $12,000. Non-air quality health impacts were evaluated, but no incremental health impacts were attributable to installation of fabric filters and ACI, because these technologies do not expose electric utility employees or the public to any additional health risks above the risks attributable to current utility operations involving compressed air systems, confined spaces, and exposure to fly ash.

The overall additional costs for the BTF option for Subcategory 2 are shown in Table 6. For the subcategory to reach MACT, no additional costs are incurred as the data displays that each unit currently meets the MACT floor. For the existing EGUs in Subcategory 2 to implement the BTF option, the additional annual cost was estimated at an additional $70,186,000 and an additional 4,040 lb/year of Hg is removed or $17,375 per lb of Hg removed.

Table 1: Capital Recovery Factor

i	0.07	interest rate
N	20	year period
CRF=	0.0544	

Equation 1: Capital Recovery Factor

$$CRF = \frac{i * (1 + i)^n}{(1 + i)^n \quad 1} = 0.0944$$

Table 2: Annualized Capital Cost

	$/(MMBtu/hr) per
ACI	108
ACI + FF	3,771
FF	3,663

Table 3: Annualized Operating Cost

	$/lb Hg removed per year
Operating	14,867

Table 4: Itemized Operating Costs

Energy costs	27	$/(MMBtu/hr) per
Non-air environmental and health costs	4,000	$/ton Hg removed

Table 5: Subcategory 2 EGUs BTF Option Impacts Estimates

Current								Non-Hg Metals or Hg MACT Floor Controls Added			Beyond-the-Hg Floor MACT Standard		
Facility Id	Boiler Id	Configuration Id	MMBtu/hr	Capacity factor	Meets MACT Floor	Meets BTF limit	Current controls	Floor controls added	Mercury reduction, lb/yr	Total Cost for Floor, $/yr	BTF controls added	Mercury reduction, lb/yr	Total Cost for BTF, $/yr
6089	B1	B1	612	76	yes	yes	ACI	FF	0.00	$ -	none	0.00	$ -
6146	1	1	9250	94	yes	yes	ACI	FF	0.00	$ -	none	0.00	$ -
6146	2	2	9250	93	yes	yes	ACI	FF	0.00	$ -	none	0.00	$ -
6146	3	3	9250	88	yes	yes	ACI	FF	0.00	$ -	none	0.00	$ -
6648	4	4	7810	88	yes	yes	ACI	FF	0.00	$ -	none	0.00	$ -
6147	2	2	7000	93	yes	no	ACI + FF	none	0.00	$ -	operating increase	153.25	$ 2,276,573
6180	1	OG1	8970	24	yes	yes	ACI + FF	none	0.00	$ -	none	0.00	$ -
6180	2	OG2	8970	24	yes	yes	ACI + FF	none	0.00	$ -	none	0.00	$ -
52071	5A	5A	2960	33	yes	yes	ACI + FF	none	0.00	$ -	none	0.00	$ -
52071	5B	5B	2960	33	yes	no	ACI + FF	none	0.00	$ -	operating increase	13.57	$ 201,691
6469	B1	AVS Unit 1	6275	94	yes	no	FF	none	0.00	$ -	ACI	282.78	$ 4,880,559
6469	B2	AVS Unit 2	6275	92	yes	no	FF	none	0.00	$ -	ACI	277.06	$ 4,795,584
7030	U1	U1	1717	88	yes	no	FF	none	0.00	$ -	ACI	38.25	$ 753,734
7030	U2	U2	1717	84	yes	no	FF	none	0.00	$ -	ACI	36.26	$ 724,145
8222	B1	001	5214	78	yes	no	FF	none	0.00	$ -	ACI	190.12	$ 3,388,556
55075	AA-001	001	2401	78	yes	no	FF	none	0.00	$ -	ACI	107.80	$ 1,661,545
55075	AA-002	002	2382	76	yes	no	FF	none	0.00	$ -	ACI	106.96	$ 1,847,047
51	24641	001	7546	85	yes	no	none	FF	0.00	$ -	ACI	306.37	$ 5,358,400
298	UM1	UM1	9061	87	yes	no	none	FF	0.00	$ -	ACI	375.74	$ 6,563,097
298	UM2	UM2	9061	91	yes	no	none	FF	0.00	$ -	ACI	394.29	$ 6,838,854
2790	B1	B1	320	71	yes	no	none	FF	0.00	$ -	ACI	10.92	$ 196,888
2790	B2	B2	900	71	yes	no	none	FF	0.00	$ -	ACI	30.72	$ 553,709
2817	1	1	2522	86	yes	no	none	FF	0.00	$ -	ACI	107.55	$ 1,883,105
2817	2	2	5130	81	yes	no	none	FF	0.00	$ -	ACI	196.17	$ 3,499,328
2823	B1	1	3200	92	yes	no	none	FF	0.00	$ -	ACI	135.45	$ 2,418,188
2823	B2	2	6300	87	yes	no	none	FF	0.00	$ -	ACI	263.36	$ 4,594,570
6030	1	Unit 1b	6015	96	yes	no	none	FF	0.00	$ -	ACI	275.38	$ 4,742,642
6030	2	Unit 2b	6022	93	yes	no	none	FF	0.00	$ -	ACI	299.35	$ 4,553,736
6183	SM-1	SMECI	4980	83	yes	no	none	FF	0.00	$ -	ACI	196.16	$ 3,482,903
7902	1	PR-1	6821	81	yes	no	none	FF	0.00	$ -	ACI	263.85	$ 4,658,644

Table 6: Subcategory 2 Incremental Hg Emissions Reduction and Cost Estimates for BTF Option

Beyond-the-Floor Total Annualized Costs (Capital + Operating)	
Additional mercury reductions for BTF limit, lb/yr	4,040
Energy costs included in total cost, $/yr	$2,300
Non-air environmental and health costs included in total, $/yr	$12,310
Total capital and operating costs for BTF limit, $/yr	$70,185,739
Total annualized capital and operating cost per lb of Hg removed	**$ 17,375**

NMA – The American Resource

THE NATIONAL MINING ASSOCIATION'S COMMENTS ON EPA'S PROPOSED NATIONAL EMISSIONS STANDARDS FOR HAZARDOUS AIR POLLUTANTS FROM COAL- AND OIL-FIRED ELECTRIC UTILITY STEAM GENERATING UNITS AND STANDARDS OF PERFORMANCE FOR FOSSIL-FUEL-FIRED ELECTRIC UTILITY, INDUSTRIAL-COMMERCIAL-INSTITUTIONAL, AND SMALL INDUSTRIAL-COMMERCIAL-INSTITUTIONAL STEAM GENERATING UNITS

76 Federal Register 24,976 (May 3, 2011)

Docket ID Numbers: EPA-HQ-OAR-2009-0234
(NESHAP action)
and
EPA-HQ-OAR-2011-0044 (NSPS)

* * *

[Page 26]

Table 2
Projected Retrofit Costs
to Comply with Proposed Acid Gas Standards
(Annual Costs, Million $)

	Commenters' Costs (FGD + FF)			
Cost Component	**Scrubbers**	**Fabric Filters**	**TOTAL**	**EPA's Costs[1] (DSI or Dry FGD + FF)**
Capital Cost	$6,579	$1,908	$8,487	$1,849
FOM	1,250	71	1,321	323
VOM	1,875	106	1,981	1,618
TOTAL	**$9,704**	**$2,085**	**$11,789**	**$3,790**

[1] Source: 76 FR 25,075 (May 3, 2011).

EPA needs to reexamine this critical assumption with actual on-the-ground testing to determine if both the efficacy and unwanted environmental side effects of DSI makes it a viable control technology.

3. Many analysts have predicted higher amounts of early coal retirements

EPA's claim of "common-sense" rulemaking is, in large part, intertwined with its DSI assumption. If EPA's unsupported assumption as to the number of units that can install DSI as a compliance strategy is wrong, the costs of complying with the acid gas standard could potentially triple, as many more units will have to install or upgrade costly scrubbing technology. This increased cost will correspondingly result in more retirements and higher electricity prices as many units will not be able to absorb the additional cost. This fact invites legitimate criticism of the agency's 10 GW retirement figure. For example, and in addition to the below chart,[58] FBR Capital Markets states that "...the practical applicability of DSI remains a debatable point due to the additional ash produced, reliability of the reagent supply chain, lack of utility sector experience with this technology, and the potential impact of dispatch. More limited adoption of this technology *could lift the retirement number above 50 GW.*"[59]

---

[58] It is important to note that each projection employed a different set of assumptions to arrive at the retirement projection – i.e. some studies analyzed the proposed rule in isolation, while others like NERA analyzed the instant rule in conjunction with other related CAA rules. The chart highlights EPA's glaring need to provide a cumulative cost estimate of all of these rules.

[59] FBR Capital Markets, Mar. 25, 2011; *see also* Dan Eggers, "Implications of EPA Policy," Credit Suisse, April 26, 2011 (estimating that retirements could be as high as 100 GW)(emphasis added).

Table 3
Summary of Coal-Fired Retirement Projections[60]

Analyst	Date of Publication	Retirement Projection (GW)
U.S. Energy Information Administration (EIA)	April 2011	45-73
NERA Economic Consulting	May 2011	48
FBR Capital Markets	March 2011	35-45
McIlvaine Company	March 2011	31-68
Edison Electric Institute (EEI)	January 2011	50
The Brattle Group	November 2010	50-66
North American Electric Reliability Corporation (NERC)	October 2010	33-77
ICF International	October 2010	75
Credit Suisse	September 2010	69

[60] Each individual analysis is filed contemporaneously with these comments (Attachment 7).

Even using EPA's own data it is entirely plausible that 50 GW will be forced to reitre based on this suite of rules. The agency's 9.9 GW retirement figure is based on forecasting the Utility MACT rule in isolation, rather than examining the agency's own base case of 25 GW gross retirements. EPA's base case estimates 299 GW of coal generation in 2015, which is an 18 GW decline in coal capacity from 2010 based on the implementation of CSAPR and Utility MACT. The base case also assumes, albeit optimistically given the inability to construct new coal plants with the stringent new source standards, an additional 7 GW in coal additions during this time.

However, this entire projection is built upon full market penetration of DSI or 56 GW. Even assuming optimistically that the development of DSI is even half the forecasted rate, which is reasonable given that half of the units targeted for DSI deployment operate without scrubbers and burn medium or high sulfur coal, the retirement number could easily jump to 50 GW. Nowhere in the record does EPA engage in this sort of analytical rigor. Rather, the agency simply assumes the best without any factual support resulting in a flawed rule with an inaccurate assessment of the true impacts.

4. <u>EPA's mistake beliefs about the current fleet will also increase the amount of projected retirements</u>

The issue of flawed retirement projections is not confined to the DSI assumption. Another aspect of this issue stems from Administrator Jackson's faulty

statements regarding the state of the current fleet. In the proposed rule, EPA

* * *

Connecticut Department of
ENERGY &
ENVIRONMENTAL PROTECTION
Daniel C. Esty, Commissioner

July 12, 2011

Assistant Administrator Gina A. McCarthy
USEPA Headquarters
Ariel Rios Building
1200 Pennsylvania Avenue, N. W.
Mail Code: 6101A
Washington, DC 20460
Docket ID No. EPA-HQ-OAR-2009-0234

Re: *Connecticut Department of Energy and Environmental Protection Comments on the Proposed Utility Air Toxics Rule*

Dear Assistant Administrator McCarthy:

Thank you for taking time out of your busy schedule to speak with me and the other OTC commissioners at our annual meeting in June. I am very pleased by the ambitious air pollution control agenda that you are prepared to advance in the coming months, which is why I am writing to you personally to express my support for EPA's proposed *National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units* (76 FR 24976; May 3, 2011). The proposal takes important steps to protect all Americans from the toxic air emissions associated with electricity generation, giving us cleaner air and facilitating a shift to more efficient, modern methods

of electricity generation, including modem coal-fired generation.

As you are well aware, Connecticut's geography makes us particularly vulnerable to emissions from the large electric generating units in the West and South. As you know, we have been quite unhappy with the ongoing pollution impacts of these plants on our citizens. We are therefore pleased to see strong national rules that will put those plants, many of which are older, coal-fired generating units, on an equal environmental regulatory footing with Connecticut's electric generators, many of which are clean, natural gas-fired plants and subject to some of the strictest emissions standards in the country. We are also pleased with the release of the Cross State Air Pollution Rule this week and look forward to your proposal of Transport Rule 2 later this year in hopes that these rules will take further decisive action to level the regulatory playing field.

I am also aware of the delicate task before you as you scrutinize the cumulative impact of these regulations on the electric generation sector. To assist your efforts, my technical staff has made recommendations to make the proposal and its implementation even better, and these suggestions are included as an attachment hereto. As the Connecticut Department of Environmental Protection recently became the Connecticut Department of Energy and Environmental Protection, our combined expertise is available to assist you to meet our shared air quality goals with an eye to our nation's economic revitalization. By

working together, I hope that we will all be able to breathe easier.

Yours truly,
Daniel C. Esty
Daniel C. Esty
Commissioner

DCE:mag

cc: Erich Eschmann, EPA Headquarters
Docket Administrator

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* * *

[Page 1]

ATTACHMENT

Technical Comments of the
Connecticut Department of Energy and
Environmental Protection on the
Proposed ***National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units***

ATTACHMENT AI: Documentation for EPA Base Case v4.10_PTox, Chapter 3, Power System Operation Assumptions; TR2012 Base-case v4.10 1PM run; NEEDS Base Case v4.10_PTox, Mar2011

ATTACHMENT A2: CTDEEP Revisions to NEEDS v4.10_PTox

ATTACHMENT B: 2008-2010 quarterly stack test results for mercury at Connecticut's coal-fired EGUs

ATTACHMENT C: Peaking Unit Trading Agreements and Orders

The Connecticut Department of Energy and Environmental Protection (CTDEEP, formerly known as Connecticut Department of Environmental Protection or CTDEP) appreciates the opportunity to comment on the "National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired. Electric Utility Steam Generating Units" (76 FR 24976, May 3, 2011), hereafter referred to as the "Utility NESHAP." CTDEEP is pleased that the U.S. Environmental Protection Agency (EPA) has acted to reduce mercury and other hazardous air pollutants

(HAPs) from electric generating units (EGUs), but CTDEEP believes the proposal could be improved in several respects. To that end, CTDEEP has joined comments submitted in this docket by the National Association of Clean Air Agencies (NACAA) and Northeast States for Coordinated Air Use Management (NESCAUM). In addition to the comments presented by those two associations, CTDEEP offers six comments on the proposal herein. One of the six areas of comment is Connecticut-specific comments on EPA's base case power system operating assumptions and the National Electric Energy Data System (NEEDS) database used in the EPA modeling for the NESHAP. Those details are included in Attachments Al and A2.

I. MERCURY LIMITS

Since 2008, Connecticut General Statute §22a-199 has limited the emissions rate of mercury from coal-fired EGUs to 0.6 lbs/TBtu or an emissions rate equal to a ninety percent reduction of mercury from measured inlet concentrations. Several other Northeast states have adopted similar requirements. The Utility NESHAP's mercury limits for coal-fired EGUs range from 1.0 lb/TBtu (1.2 lb/TBtu as referenced in EPA's letter to Utility Air Regulatory Group on 5/18/11) to 4.0 lb/TBtu, levels significantly less stringent limits than those in the Northeast. While CTDEEP understands that the nation's coal-fired EGUs include units much larger and using a range of technologies much broader than those in Connecticut, **CTDEEP recommends that EPA establish an achievable mercury NESHAP standard demonstrated in practice. The**

compliance history of Connecticut's EGUs shows that its coal-fired units comply at levels

[Page 2]
below Connecticut's 0.6 lbs/TBtu limitation. Quarterly stack test data from 2009-2010 (and the first quarter of 2011 for one of the facilities) are provided in Attachment B.

II. BETTER DEFINE THE LIMITED-USE SUBCATEGORY

At FR 25027, EPA indicates a willingness to include:

> *"...a limited use-subcategory to account for liquid oil-fired units that only operate a limited amount of time per year on oil and are inoperative the remainder of the year. Such units could have specific emission limitations, reduced monitoring requirements (limited operation may preclude the ability to conduct stack testing), or be held to the same emission limitations (which could be met through fuel sampling) as other liquid oilfired units."*

However, EPA does not give any details, such as specific number of hours, to describe what "limited amount of time" means, and the phrase is open to interpretation. **EPA should define what constitutes a "limited amount of time" and allow for public comment when it has established a framework. The ability of sources to operate under a limited use-subcategory could significantly impact compliance costs and requirements associated with the Utility NESHAP. Also, the breadth of a limited use**

subcategory could influence other state programs to address emissions from units that operate for limited circumstances.

At page 25107 of the Utility NESHAP (40 CFR section 63.10006(s)), the opportunity to demonstrate compliance with the mercury, individual or total non-mercury HAP metals, hydrochloric acid (HCl), or hydrofluoric acid (HF) emissions limit based on fuel analysis seems broader than the liquid oil-fired limited use subcategory. **If it is not EPA's intention to allow units other than liquid oil-fired limited use units to utilize a fuel analysis compliance mechanism, EPA should clarify the language.**

III. TESTING REQUIREMENTS

For states with several EGUs subject to the Utility NESHAP, workload in observing emission tests and/or reviewing emission test protocols could greatly increase. For example, CTDEEP estimates that implementing the testing requirements of the Utility NESHAP could increase the workload of CTDEEP's emission testing staff by as much as 50%. The emissions testing staff ensures that testing is done in accordance with EPA methods. Given state resource constraints, additional staff would need to be taken from other duties to perform testing functions. Testing without adequate quality monitoring does not necessarily support compliance determinations. **CTDEEP recommends that EPA consider revising the applicable monthly and bimonthly testing requirements in Section 63.10006 to quarterly testing requirements in order to provide a reasonable window of time**

for sources and states to maintain quality testing and review procedures.

It is not clear that the language at FR25107 (section 63.10006(p)) applies to low-emitting EGUs, and it is difficult to understand how the timing set out in section 63.10006(o) follows in section 63.10006(p). For example, it is unclear what the term "continue to meet" in section 63.10006(p)

DHEC
Promote Protect Prosper
C. Earl Hunter, Commissioner
Promoting and protecting the health of the public and the environment

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SOUTH CAROLINA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL CONTROL
2600 Bull Street • Columbia, SC 29201 •
Phone:(803)898-3432 • www.scdhec.gov

July 20, 2011

United States Environmental Protection Agency
EPA Docket Center, EPA West (Air Docket)
Air and Radiation Docket, Mail Code 2822T
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Attention: Docket ID No. EPA-HQ-OAR-2009-0234

Re: Federal RegisterNol. 76, No. 85/Tuesday, May 3, 2011/Proposed Rules. National Emission Standards for Hazardous Air Pollutants From Coal and Oil-Fired Electric Utility Steam

Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small IndustrialCommercial- Institutional Steam Generating Units

To Whom It May Concern:

Thank you for the opportunity to provide comments on the proposed rule entitled *National Emission Standards for Hazardous Air Pollutants [NESHAP]for Coal- and Oil-fired Electric Utility Steam Generating Units and Standards of Performance [NSPS]for Fossil-Fuel-Fired Electric Utility, Industrial Commercial-Institutional, and Small Industrial-CommercialInstitutional Steam Generating Units.*[1] The South Carolina Department of Health and Environmental Control (DHEC) is the public health and environmental agency for the State of South Carolina, and we are committed to promoting and protecting the health of the public and the environment for the State of South Carolina.

This letter provides comments only on the NESHAP part of the proposed rule, commonly referred to as the "Utility MACT."[2] DHEC generally supports actions taken by the United States Environmental Protection Agency (EPA) to address the hazardous air pollutants that the Utility MACT would regulate, but DHEC has technical concerns about the proposal. Furthermore, DHEC is concerned with the

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[1] 76 Fed. Reg. 24976 (May 3, 2011).

[2] "MACT" refers to the maximum achievable control technology for utilities that the proposed NESHAP would require.

implementation of certain portions of the proposed Utility MACT as written. The EPA has delegated authority to implement NESHAPs to many states, including South Carolina, and we request that the EPA take into consideration the additional burden the Utility MACT and other recently promulgated rules (e.g. the Boiler MACT) pose to states' already strained resources. DHEC asks the EPA to develop a rule that not only reduces air pollution but provides for efficient implementation and enforcement by the delegated authorities.

Mercury is one of the hazardous air pollutants that the Utility MACT would regulate. The cumulative contribution of past and present mercury emissions from local, regional, and global sources affects South Carolina. DHEC is taking action to address mercury through the South Carolina Mercury Assessment and Reduction Initiative.[3] This initiative is a cooperative effort to identify ways that the public, interested groups, industry, and government can address mercury in the environment. The initiative relies in part on the EPA to meet its obligations under the Clean Air Act (CAA) to promulgate lawful standards to address mercury.

The following are comments that DHEC would like for the EPA to consider before promulgation of the final Utility MACT. We offer comments on emissions averaging, the relationship between the Utility MACT and other NESHAPs, performance testing, definitions, and tables. Finally, we note possible

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[3]http://www.scdhec.gov/environment/admin/mercury/htm/initiative.htm (Last visited May 12, 2011).

typographical errors. If there are significant changes to this proposed rule, we believe the EPA should provide appropriate process and time to comment on the changes.

1) Emission Averaging Compliance Option

The EPA proposes to require facilities choosing to demonstrate compliance by the emission averaging option to submit an "implementation plan" for review and approval by the delegated authority. However, the EPA did not provide a clear process for implementing and enforcing this complex compliance option. We strongly request that the EPA eliminate the requirement for delegated authorities to approve implementation plans and instead develop an emission averaging certification mechanism within the Notice of Compliance Status (NOCS). The NOCS process is established, and states have experience implementing it.

The EPA included an emission averaging compliance option in the Boiler MACT. DHEC comments that the EPA should be consistent in applying the emission averaging compliance option for the Boiler and Utility MACTs.

a) Emission Caps For Existing Affected Sources Choosing To Demonstrate Compliance By The Emission Averaging Option Cannot Be Effectively Implemented Or Enforced. The Emission Cap Should Be Included In The Compliance Calculations.

We believe that the requirement to establish an emission cap and submit an implementation plan to

the permitting agencies for approval is problematic as written. Because the emission cap is not used in the initial compliance demonstration or in demonstrating continuous compliance with the emission averaging option, it is of little use.

If the intent of this option is for facilities to not exceed the cap at any time, then the EPA should include a demonstration methodology that shows that a facility is not exceeding the cap in the compliance equations in section 63.10009. If the cap is included in the compliance equations, facilities could certify compliance with the cap in the NOCS and within each required semiannual report. Additionally, if the initial and continuous compliance measures include the emission cap, the implementation plan will not be necessary and states will not have to spend valuable time and resources to approve these duplicative plans.

DHEC received several implementation plans from facilities trying to comply with the vacated Boiler MACT in 2007. We encountered many problems with the approval process and received little help and guidance from the EPA. The EPA proposed the same approval process in the Utility MACT, disregarding the known problems states faced in 2007 trying to implement the emission averaging compliance option in the vacated Boiler MACT.

b) Requirement For Delegated Agencies To Approve Implementation Plans Is Burdensome And Unnecessary. The EPA Should Provide Specific Guidance And Examples On What Constitutes An Acceptable Emission Cap.

As stated above, the requirement to establish an emission cap and submit an implementation plan to the permitting agencies for approval is problematic as written. DHEC noted this issue in our comments for the 2010 proposed Boiler MACT. While the EPA attempted to correct the enforceability problem related to the emission cap in the final Boiler MACT by requiring facilities to report the emission cap in the NOCS (see 40 CFR 63.7545(e)(5)(i)), and certify compliance with the cap in the compliance reports (see 40 CFR 63.7550(c)(13)), there is no guidance or clear process on what constitutes an acceptable and enforceable emission cap that delegated agencies can follow to approve the cap.

If the EPA decides that the submittal and approval of implementation plans are necessary for the emission averaging compliance option, DHEC believes that the EPA should retain the authority to approve the implementation plans.

c) The EPA Should Clarify Deadline To Establish Emission Caps To Demonstrate Compliance With The Emission Averaging Option For The Emission Level Or Control Technology.

In section 63.1 0009(c), the emission rate achieved during the initial compliance test for the hazardous air pollutant ("HAP") associated with an existing EGU in the averaging group must not exceed the emission level that was being achieved on [THE DATE 30 DAYS AFTER PUBLICATION OF THE FINAL RULE IN THE FEDERAL REGISTER] or the control technology employed during the initial compliance test must not be less effective for the

HAP being averaged than the control technology on [THE DATE 30 DAYS AFTER PUBLICATION OF THE FINAL RULE IN THE FEDERAL REGISTER]. However, the EPA proposes in section 63.10009(g)(2)(i) that information associated with the applicable HAP emission level or the control technology installed as of [DATE 60 DAYS AFTER PUBLICATION OF THE FINAL RULE IN THE FEDERAL REGISTER] be included in the required emissions averaging plan. This appears to be a contradiction in dates and the EPA should correct this in the final rule.

d) There Are Errors In Performance Tests Language.

In section 63.1 0009G)(2), the EPA proposes that, "If affected units from nonaffected units vent to the common stack, the units from nonaffected units must be shut down or vented to a different stack during the performance test."[4] There appears to be a grammatical error in this clause: It is unclear as to how one can have "affected units from nonaffected units" (emphasis added).

e) The EPA Should Clarify Requirement To Submit An Implementation Plan For Emission Averaging Compliance Option.

There is a contradiction in section 63.1 0009(g)(l).[5] This section mandates the submittal of an implementation plan by using the word "must."

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[4] 76 FR, at 25110.

[5] *Id.*

However, section 63.10009(g) seems to indicate that submittal of the implementation plan is only necessary "upon request."[6] This apparent discrepancy should be corrected in the final rule to avoid confusion.

f) The EPA Should Clarify Reference To Representative Operating Conditions And Maximum Normal Operating Load.

Section 63.1 0009(e) requires performance tests to be conducted at "maximum normal operating load."[7] However, section 63.10009(g)(2)(vii) requires demonstration of compliance with each of the applicable emission limit(s) to be achieved under "representative operating conditions."[8] The EPA needs to clarify this discrepancy and clearly define in section 63.10042 what constitutes maximum normal operating load or representative operating conditions.

g) The EPA Should Make Technical And Editorial Corrections.

Section 63.10009(a) states "you may demonstrate compliance by emission averaging among the existing EGUs in the same subcategory, if your averaged emissions for such EGUs are equal to or less than the applicable emission limit"[9] (emphasis added). However, section 63.10009(e)(l) states, "You

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[6] *Id.*

[7] *Id.* at 25108.

[8] *Id.* at 25110

[9] *Id.* at 25108

must use equation 1 ofthis section to demonstrate that the PM, HF, SO_2, HCl, nonHg HAP metals, or Hg emissions from all existing units participating in the emissions averaging option do not exceed the emission limits in Table 2"[10] (emphasis added). The EPA needs to use the same wording in both sections in order to avoid confusion.

h) The EPA Should Clarify Equation 1.

Section 63.10009(e)(1) requires a facility to use Equation 1 to demonstrate compliance with PM, HF, SO2, HCl, non-Hg HAP metals or Hg emissions, by using the emission rate as determined during the most recent performance test and the maximum rated heat input capacity. Due to the variability in reported heat input ratings for utility boilers, and there not currently being a definition in place on what maximum rated heat input capacity is, DHEC asks that the EPA addresses this in the final rule and establish a definition of what constitutes the maximum rated heat input capacity of a utility boiler.

2) Transitioning From Boiler MACT/Area Source Boiler MACT To Utility MACT And Vice Versa

The preamble discusses the following scenario:

> [T]here will likely be some cogeneration units that are determined to be covered under the Boiler NESHAP. Such unit may make a decision to increase/decrease the proportion

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[10] *Id.*

> of production output being supplied to the electric utility grid, thus causing the unit to meet the EGU cogeneration criteria (i.e., greater than one-third of its potential output capacity and greater than 25 MWe). A unit subject to one of the Boiler NESHAP that increases its electricity output and meets the definition of an EGU would be subject to the proposed EGU NESHAP for the 6-month period after the unit meets the EGU definition. Assuming the unit did not meet the definition of an EGU following that initial occurrence, at the end of the 6- month period it would revert back to being subject to the Boiler NESHAP.[11]

The EPA solicits comment on the extent to which this situation might occur and whether the 6- month period is appropriate. There are several cogeneration units in South Carolina that could potentially follow the above-mentioned scenario. The EPA did not address the regulatory logistics on how this would be implemented. We request that the EPA provide in the final rule a clear process to demonstrate initial and continuous compliance for cogeneration units changing section 112 applicability. This process needs to provide the specific period or deadline when the cogeneration unit stops compliance with the Boiler MACT and starts complying with the Utility MACT and vice versa, include notification requirements when changing rules, and specify testing and NOCS deadlines.

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[11] *Id.* at 25026.

In addition, the EPA should address how the "once-in-always-in" policy applies to sources subject to the Boiler MACT that become subject to the Utility MACT when the source meets the EGU cogeneration criteria.

3) Transitioning From CAA Section 112 To Section 129 And Vice Versa.

The EPA solicits comment on whether they should include provisions similar to those included in the final CISWI rule[12] to address units that combust different fuels at different times. Several utility boilers in South Carolina have the potential to combust materials that could be considered solid waste under the proposed RCRA definition. These are utility boilers that do not meet the exemption under CAA section 129 (g)(1)(B) for qualifying small power production facilities or qualifying cogeneration facilities. DHEC recommends the EPA include provisions similar to those included in the final CISWI rule to address units that combust different fuels at different times.

4) Performance Testing

a) The EPA Should Clearly Specify Testing Conditions To Demonstrate Compliance With Emission Limits.

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[12] Standards of Performance for New Stationary Sources and Emission Guidelines for Existing Sources: Commercial and Industrial Solid Waste Incineration Units, 76 Fed. Reg. I5704 (March 21, 2011).

In section 63.10007, the EPA proposes that affected sources conduct performance tests at the "maximum normal operating load."[13] However, this maximum normal operating load is not defined in the proposed rule. Facilities use different fuels depending on many variables such as availability and cost. Fuels are also combusted in different proportions throughout the year. The EPA should provide a clear definition of maximum normal operating load or representative operating conditions in section 63.10042. The EPA should also clearly define how a source that utilizes more than one fuel should comply with this requirement. Having this clearly defined is necessary not only for determining compliance with the emission standards, but also for adequately approving site-specific test plans.

In addition, there appears to be an inconsistency between the testing conditions specified in section 63.10007(c) and (f). While section 63.10007(c) requires facilities to conduct performance tests at the "maximum normal operating load,"[14] section 63.10007(f) requires facilities to conduct performance tests under such conditions as the EPA Administrator specifies to the owner or operator based on "representative performance" of the affected source for the period being tested.[15]

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[13] 76 FR, at 25I07.

[14] *Id.*

[15] *Id.* at 25107-25108.

5) Definitions

a) The EPA Should Provide Reasoning For Having Different Definitions For Natural Gas In The NSPS and The NESHAP.

The EPA proposes to amend the NSPS definition of natural gas in 40 CFR 60.41 to be:

> (1) A naturally occurring mixture of hydrocarbon and nonhydrocarbon gases found in geologic formations beneath the earth's surface, of which the principal constituent is methane; or
>
> (2) Liquid petroleum gas, as defined by the American Society of Testing and Materials in ASTM D1835 (incorporated by reference, see 60.17); or
>
> (3) A mixture of hydrocarbons that maintains a gaseous state at ISO conditions. Additionally, natural gas must either be composed of at least 70 percent methane by volume or have a gross calorific value between 34 and 43 megajoules/MJ) per dry standard cubic meter (910 and 1,150 Btu per dry standard cubic foot).[16]

The EPA's proposed definition of natural gas in the Utility MACT in 40 CFR 63.10042 states:

> (1) A naturally occurring mixture of hydrocarbon and nonhydrocarbon gases

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[16] *Id.* at 25091.

> found in geologic formations beneath the earth's surface, of which the principal constituent is methane; or
>
> (2) Liquid petroleum gas, as defined by ASTM Method D1835-03a (incorporated by reference, see section 63.14(b)(41)).[17]

The definition of natural gas should be the same for the NSPS and the NESHAP. If the EPA believes these definitions need to be different, then the EPA should clearly state the reasoning for the difference in the preamble of the rule.

b) The EPA Should Provide Reasoning For Having Different Definitions For Distillate Fuel In The NSPS And The NESHAP.

The EPA proposes the following definition of distillate fuel in 40 CFR 63.10042:

> (1) *Distillate oil* means fuel oils, including recycled oils, that comply with the specifications for fuel oil numbers 1 and 2, as defined by ASTM Method D396-02a (incorporated by reference, see 63.14(b)(40)).[18]

The EPA's proposed definition of distillate oil in 40 CFR 60.41 b includes the wording *"Distillate oil* means fuel oils that contain 0.05 weight percent nitrogen or less and comply with the specifications

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[17] *Id.* at 25123.

[18] *Id.* at 25122.

for fuel oil numbers 1 and 2."[19] DHEC requests that the EPA provides reasoning as to why the definitions for distillate oil in subparts Db of the NSPS contain a limitation on the weight percent nitrogen, while the proposed definition for the Utility MACT does not.

6) Technical And Editorial Corrections To Tables

There are several inconsistencies and mistakes in the Utility MACT tables. It appears the EPA did not conduct a thorough review of the Utility MACT before releasing it to the public for comment. Based on many years of experience implementing NESHAPs at the state level, poorly written rules make the implementation and enforcement process unnecessarily difficult, extremely confusing, and resource-intensive.

a) The EPA Should Correct The Total Particulate Matter (PM) Reference In Table 1.

Table 1 uses "particulate matter" instead of "total particulate matter" as the pollutant for IGCC and solid oil-derived fuel fired units.[20] The preamble of the rule clearly states that total particulate matter (filterable and condensable) is the pollutant being regulated. This inconsistency needs to be corrected in order to avoid confusion.

b) The EPA Should Correct Work Practice Periodic Performance Test Reference In Table 3.

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[19] *Id.* at 25099.

[20] *Id.* at 25125.

Table 3 states that EGUs must conduct annual performance tests for work practice standards as specified in section 63.10005.[21] Section 63.10005 does not have any reference for tune-up work practice performance tests to be conducted annually. Perhaps the EPA intended to reference section 63.10006(r) which requires facilities meeting applicable tune-up work practice standards do so no later than 18 months after the previous performance tune-up. The correct citation and period testing should be reflected in Table 3.

c) The EPA Should Correct References To Fuel Analysis Operating Limits In Table 4.

Table 4 incorrectly references sections 63.10011(d)(3), (4), and (5) as the fuel analysis procedures to demonstrate compliance with the applicable limits.[22] The correct procedures are provided in section 63.10011(c).

d) The EPA Should Correct References To Operating Limits In Table 7.

Table 7 incorrectly references section 63.10011(c) to establish the minimum pressure drop, minimum flow rate, minimum pH, minimum sorbent injection, and secondary power input operating limits.[23] Section 63.10011(c) provides procedures to demonstrate compliance with applicable emission limits through

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[21] *Id.* at 25129.

[22] *Id.* at 25129.

[23] *Id.* at 25133.

fuel analysis. The requirements for establishing operating limits are provided in section 63.10011 (b).

e) The EPA Should Correct Table 9 To Reflect That Reports Related To Startup, Shutdown, And Malfunction Plans (SSM) Are Not Required.

Items 1(d) and 2 of Table 9 of the rule require facilities to submit the information in section 63.10(d)(5)(i) in the periodic reports or an immediate SSM report based on whether facilities follow their SSM plans.[24] However, Table 10 clearly states that SSM plans are not required to be developed for EGUs.[25] This discrepancy should be corrected in the final rule.

7) Miscellaneous

a) The EPA Should Correct Exemption For Natural Gas-fired EGUs.

Section 63.9983(b) exempts any EGU that is not a coal- or oil-fired EGU and combusts natural gas more than 10.0 percent ofthe average annual heat input during the previous 3 calendar years or for more than 15.0 percent of the annual heat input during any one of those calendar years.[26] This exemption contradicts the preamble ofthe rule. DHEC suggests that the EPA use the language in the preamble for the exemption:

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[24] *Id.* at 25134.

[25] *Id.* at 25135.

[26] *Id.* at 25102.

If a new or existing EGU that is not coal- or oil-fired, and the unit burns natural gas exclusively or natural gas in combination with another fuel where the natural gas constitutes 90 percent or more of the average annual heat input during the previous 3 calendar years or 85 percent or more of the annual heat input during any one of those calendar years, the unit is considered to be natural gas-fired and would not be subject to this subpart.[27]

b) The EPA Should Specify Database For Submittal Of Performance Tune-ups.

Section 63.1 0021(a)(16)(vii) requires facilities to submit a notice of completion of the performance tune-up to the EPA by successfully submitting the data electronically into an EPA database.[28] The EPA should clarify whether the performance tune-up needs to be submitted electronically to the EPA's Central Data Exchange (CDX) by using the Electronic Reporting Tool (ERT) as required in other parts of this section (63.10021(a)(11) and (17)).

c) The EPA Should Provide Reasoning For Not Requiring SSM Plans.

Table 10 ofthe proposed rule addresses applicability of General Provisions to Subpart UUUUU. This table states that the requirements in sections 63.6(e)(3) and 63.8(d)(3) to develop a written startup, shutdown, and malfunction plan do not apply.[29] The

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[27] *Id.* at 25020.

[28] *Id.* at 25117.

[29] *Id.* at 25135.

EPA did not provide reasoning in the preamble for not requiring facilities to develop a written startup, shutdown, and malfunction plan for the affected sources, their control devices, and their continuous monitoring systems (CMS).

d) DHEC Notes Typographical Errors

First, in section 63.10005(k), the last paragraph on start-up and shutdown default values for calculations is numbered as (1).[30] The last paragraph should be labeled as (4) to continue the numbering of the section. Second, section 63.10011 (c) states "and follow the procedures in paragraphs (c)(1) through (c)(7) ofthis section."[31] There are only 6 paragraphs in section 63.10011 (c). Third, the word "limit" is missing at the end of the last sentence of section 63.1 0011(b)(6)(iv).[32]

e) The EPA Should Develop An Appropriate Compliance Extension Process For The Construction Of On-site Replacement Power

The EPA is taking comment on allowing states to interpret "installation of controls" in CAA 112(i)(3)(B) and 40 CFR 63.6(i) to allow for replacing a unit as a reason for granting requests for one-year extensions to the compliance date.[33] DHEC notes that if EPA adopts the policy that "installation of controls" can mean replacing a unit, it should do so

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[30] *Id.* at 25106.

[31] *Id.* at 25114.

[32] *Id.* at 25114.

[33] *Id.* at 25055.

through a more formal rulemaking process, either in the Utility MACT or in the NESHAP General Provisions, rather than through preamble discussion or a guidance document.

As a final general comment, we believe that the EPA should take into consideration how this rule could affect the emissions of non-HAP pollutants and whether the rule produces the greatest overall air quality and public health improvement. The EPA's current approach to regulating air emissions does not prioritize pollutants for comprehensive air quality management and in some cases may exacerbate air quality issues.

Thank you for the opportunity to provide comments on this proposed action. If you have questions, please contact Heinz Kaiser, Air Toxics Section Manager ofthe Bureau of Air Quality at 803-898-4089, or by email at kaiserh@dhec.sc.gov.

Sincerely,
Myra C. Reece
Myra C. Reece, Chief
Bureau of Air Quality

cc: Beverly Banister, USEP A Region 4
Robert W. King, Jr., P.E.,
Deputy Commissioner, SCDHEC-EQC

MassDEP Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs
Department of Environmental Protection
One Winter Street Boston, MA 02108 * 617-292-5500

Deval L. Patrick
Governor

Richard K. Sullivan Jr.
Secretary

Timothy P. Murray
Lieutenant Governor

Kenneth L. Kimmell
Commissioner

July 29, 2011

The Honorable Lisa P. Jackson
US Environmental Protection Agency
EPA Docket Center (EPA/DC), Mailcode: 2822T
1200 Pennsylvania Ave., NW
Washington, DC 20460
Docket ID No. EPA-HQ-OAR-2009-0234 (NESHAPS)
EPA-HQ-OAR-2011-0044 (NSPS)

Via e-mail to: A-and-R-Docket@epa.gov, Attention EPA-HQ-OAR-2011-0044 (NSPS action) or EPA-HQ-OAR-2009-0234 (NESHAP action)

Re: Comments on Proposed Utility MACT and NSPS Rules

Dear Administrator Jackson:

The Massachusetts Department of Environmental Protection (MassDEP) is pleased to submit the attached comments on the U.S. Environmental Protection Agency's (EPA) proposed rulemaking, published in the Federal Register on May 3, 2011 (76 FR 24976), entitled *National Emission Standards for*

Hazardous Air Pollutants from Coal- and Oil-fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units.

MassDEP appreciates the opportunity to express its support for EPA's proposed rulemaking. To begin with, Massachusetts believes that the EPA Utility Maximum Achievable Control Technology (MACT) proposal is an improvement over the vacated Clean Air Mercury Rule (CAMR) and will reduce emissions of a variety of hazardous air pollutants, in particular mercury, which can have significant local, national and global impacts on the environment and on children's health. The proposed regulations appropriately address power plant emissions under section 112 of the Clean Air Act and thus include no provisions for emissions trading, instead relying on MACT for the covered pollutants, consistent with the requirements of the Clean Air Act. These reductions are necessary to protect the environment and human health from acid gases, dioxins and metals, in particular mercury. As EPA is aware, reducing power plant emissions nation-wide will improve environmental quality and public health not only in those states where the emissions originate, but also in all areas downwind of these facilities.

[Page 2]
The experience of Massachusetts in imposing stringent emissions limits for mercury and other pollutants clearly shows that EPA's proposed limits are achievable and effective. For example, although

the Massachusetts mercury emission limits for existing coal-fired power plants are considerably more stringent than those proposed by EPA, Massachusetts facilities have been able to install control equipment with no impact on reliability of the electric power grid and have demonstrated consistent compliance with the limits. Moreover, ongoing monitoring efforts in Massachusetts and other states indicate that mercury levels in fish and other biota have fallen as we have addressed our region's sources of mercury pollution. This evidence indicates that mercury reduction requirements like those enacted in Massachusetts are effective at reducing environmental mercury levels, and are a worthwhile investment.

In addition to those direct environmental benefits, the proposed regulations will help level the playing field. Massachusetts and several other states have dramatically reduced mercury and other harmful emissions from local power plants. The fact that we have done this in the absence of federal regulation of mercury not only puts us at a competitive disadvantage, but also means that we do not enjoy the full benefit of this reduction because we are downwind of states that have not imposed similar controls. The proposed rules go a long way in addressing this inequity.

Although Massachusetts is very supportive of the draft regulations overall, we note that some elements of the MACT assessment could be improved upon, which would likely lead to more stringent limits that are both achievable and will result in greater reductions of emissions. Towards this end, we

encourage EPA to carefully reanalyze its development of the MACT standards to more accurately reflect the actual observed emissions of the best performing 12% of facilities.

Our major concerns, which are outlined in greater detail in Attachment A, are:

- The proposed MACT emission limits for mercury are higher than necessary. Greater reductions in emissions are feasible and supported by the data.

- EPA should establish net output-based standards to encourage efficient use of fuel and equipment.

As noted above, Massachusetts has already promulgated regulations limiting mercury emissions from the large coal-fired power plants in Massachusetts that will be subject to the MACT regulation. The regulations limit mercury emissions based on the capture of mercury or on the amount of electricity generated by the facility. The limits are established in two phases.

Massachusetts facilities are meeting the Phase 1 standards which came into effect on January 1, 2008. These are considerably more stringent than those advanced by EPA (0.0075 pounds of mercury per net gigawatt-hour of electricity generated under the Massachusetts regulations vs. 0.013 under the EPA proposal). Under Phase 2 of the Massachusetts regulation, effective October 1, 2012, these facilities will be required to capture at least 95% of the mercury in the facility's coal or emit no more than 0.0025 pounds of mercury per net gigawatt-hour of electricity generated. These Massachusetts

regulations are tough, achievable standards. EPA should adopt standards similar to Massachusetts' through the federal MACT process and must ensure that the states continue to have the flexibility to implement more aggressive standards.

Finally, Massachusetts urges EPA to move expeditiously to finalize the regulations by the court-ordered deadline in November so that the work of reducing power plant emissions can begin and reductions are achieved in

[Page 3]
Thank your consideration of these comments. I look forward to working with EPA as we continue to address toxics pollution in our efforts to achieve local and regional air quality improvements in a timely manner.

Sincerely,

Kenneth L. Kimmell

Kenneth L. Kimmell
Commissioner

Cc: Secretary Richard K. Sullivan, Jr., MA EOEEA
Curt Spalding, EPA New England Regional Administrator
Enclosure

* * *

Attachment A

Massachusetts Department of Environmental Protection
Technical Comments on Proposed Utility MACT & NSPS Rules
Docket ID No. EPA-HQ-OAR-2009-0234& EPA-HQ-OAR-2011-0044

Improvement over CAMR

EPA's proposed standards are a great improvement over the vacated Clean Air Mercury Rule (CAMR). On February 8, 2008, the US Court of Appeals for the District of Columbia Circuit vacated CAMR in response to suits by a number of petitioners, including Massachusetts, who were concerned that the mercury emissions trading allowed under CAMR could create, exacerbate or perpetuate existing mercury hotspots. The Court concurred with the petitioners' claims that CAMR inappropriately used a trading approach under Section 111 of the Clean Air Act, rather than requiring emissions to be controlled using Maximum Achievable Control Technology (MACT) under Section 112.

The proposed regulations appropriately address power plant emissions under section 112 of the Clean Air Act by requiring maximum achievable control technology, rather than emission trading. This approach is consistent with the requirements of the Clean Air Act, and will achieve more substantial and faster reductions in emissions of mercury and other hazardous air pollutants (HAPs) than under CAMR.

Certain MACT Limits Should be Reanalyzed

The Massachusetts Department of Environmental Protection (MassDEP) agrees with the comments regarding the calculation of the proposed MACT and New Source Performance Standard (NSPS) rules submitted by the Northeast States for Coordinated Air Use Management (NESCAUM) and the National Association of Clean Air Agencies (NACAA).

In order to comply with Congress' intent that MACT standards achieve at least the performance exhibited by the average of the top-performing 12% of sources, EPA's calculations should be revised to more accurately reflect the actual performance of the top-performing units. MassDEP therefore urges EPA to review some elements of its statistical approach to determining emission limits, and adopt final emission limits more in line with the technology analyses presented by the Ozone Transport Commission in its January 27, 2004 *Multi-Pollutant Strategy Position of the Ozone Transport Commission*, and by the State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials' (STAPPA/ALAPCO's, now NACAA) May 7, 2002 *Principles for a Multi-Pollutant Strategy for Power Plants* and March 12, 2004 analysis of those principles. This is also consistent with NESCAUM's March 31, 2011 *Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants*.

Mathematical issues with EPA's development of the proposed standards include:

Emission Data for MACT Floor Variability Analysis
As can be seen in the following chart, EPA's MACT variability analysis resulted in a 5-fold increase in the allowable emissions of mercury above the actual average performance data reported for the top-performing 12% of units, and 56-fold increase above the cleanest performance data for those units. Variability was largely attributable to a small number (4 tests series out of the 80 considered) of anomalously high emission test results at only 4 units. Three of these test results were two orders of magnitude (100-fold) higher than the average emissions of the other data obtained from the top performing 12% of units and fall more than two standard deviations from the mean of the log transformed dataset, as calculated using STATISTICA (StatSoft, Inc. (2011), data analysis software system, version 10; www.statsoft.com). These should be investigated as outliers to be corrected or excluded from the analysis. One of these test series (the 2.43 pound per Trillion British thermal units (Btu) value for BL Massachusetts Department of Environmental Protection Utility MACT Comments July 29, 2011 Page 6 of 13

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[Page 6]
HAPs Beyond Mercury and Nickel
MassDEP supports EPA addressing additional HAPs beyond the two pollutants (nickel and mercury) addressed in the vacated CAMR. Other metals such as arsenic, and other toxics such as HCl, are also emitted from utility boilers. EPA's inclusion of multiple HAPs in the proposed rule is appropriate as it will be more cost effective for power plants to

address toxic emissions together rather than piecemeal.

Health Effects of Mercury

Emissions of HAPs from power plants are of great concern to Massachusetts. Due to prevailing weather patterns and winds that carry pollutants into our region, out-of-state power plants are a significant source of air pollution, including mercury deposition, in Massachusetts and across the northeast. Mercury is of great concern because it is a potent neurotoxin, particularly to the developing brain of the fetus and young child. Even small amounts of mercury are harmful – a two-pound fish containing less than 1/100,000th of an ounce of mercury is unsafe to eat. Extensive scientific research also demonstrates widespread mercury pollution in Massachusetts and across New England, largely attributable to air deposition of mercury. All New England states have fish consumption advisories in effect because of elevated levels of mercury. These advisories cover thousands of lakes, ponds and reservoirs, and tens of thousands of river miles. Because of widespread pollution, mercury's potent toxicity and its ability to bioaccumulate in the food chain, tens of thousands of children in the northeast are exposed to unacceptable levels of mercury each year, primarily due to in utero exposures attributable to their mothers' consumption of contaminated fish.

As required under the US Clean Water Act, Massachusetts, together with the other New England states and New York, completed an assessment of the maximum amount of mercury pollution that freshwater bodies can tolerate and still

have fish that are safe to eat. This New England regional total maximum daily load (TMDL) for mercury concluded that anthropogenic mercury pollution will ultimately need to be reduced by 87 to 98 percent to allow for the safe consumption of fish from many lakes and ponds in our region. This is necessary to comply with the requirements of the Clean Water Act, and, more importantly, to protect our children and our environment. In order to achieve reductions of this magnitude, the maximum level of control of mercury emissions will need to be achieved from all significant sources, particularly coal-fired power plants, which constitute the largest unregulated national source (as the finalized MACT standards will be the first national mercury limits).

Precedent for the Effectiveness of Strong Mercury Emission Control

MassDEP has been working on mercury pollution since the 1990s, leading national and international efforts to reduce mercury pollution. To address our sources of mercury pollution, Massachusetts has been and continues to implement a statewide multimedia mercury strategy as part of a regional effort through the New England Governors' and Eastern Canadian Premiers' Mercury Action Plan. Under these initiatives, Massachusetts and regional sources of mercury pollution, including coal-fired electric generating units, have been dramatically reduced.

State and regional mercury reduction efforts have clearly demonstrated that large reductions in mercury releases are achievable. For example, Massachusetts and many other states have stringent

regulations on mercury emissions from Municipal Solid Waste Combustors. At the time these regulations were adopted, some claimed they were technologically impossible. Experience has shown these concerns to be unfounded. This sector stepped up to the plate and through the use of up-to-date air pollution controls, including activated carbon injection, scrubbers and particulate controls, has met, and in many cases exceeded, our state standards. These types of pollution controls are well demonstrated to be effective and feasible but are now in use at only some of the nation's utilities. We think that EPA should establish similarly strong requirements for the highest emitting sources, utilities.

[Page 7]
In June 2004, Massachusetts promulgated regulations that limit mercury emissions from the large coal-fired power plants in Massachusetts that will be subject to EPA's MACT regulations. The regulations limit mercury emissions based on the capture of mercury or on the amount of electricity generated by the facility. The limits in Massachusetts regulation 310 CMR 7.29 are established in two phases:

- In Phase 1, by January 1, 2008 each facility must capture at least 85% of the mercury in the coal burned by the facility or emit no more than 0.0075 pounds of mercury per net gigawatt-hour of electricity generated (calculated as a rolling annual average).

- In Phase 2, by October 1, 2012 each facility must capture at least 95% of the mercury in the

facility's coal or emit no more than 0.0025 pounds of mercury per net gigawatt-hour of electricity generated (calculated as a rolling annual average).

Massachusetts facilities are meeting the Phase 1 standards currently in effect. Other states have also adopted more stringent mercury limits than EPA is proposing. The Massachusetts regulations contain tough, achievable standards that should be required throughout the United States. Although the Massachusetts mercury emission limits for existing coal-fired power plants are considerably more stringent than those proposed by EPA, Massachusetts facilities have been able to install control equipment with no impact on reliability of the electric power grid and have demonstrated consistent compliance with the limits. Therefore, based on state experience, EPA's proposed mercury limits are certainly achievable and could well be tightened.

In addition to leading to significant mercury reductions, EPA's new rules will level the playing field. Massachusetts and several other states have dramatically reduced mercury and other harmful emissions from local power plants. The fact that we have done this in the absence of federal regulation of mercury means that we do not enjoy the potential benefit of achievable mercury reductions because we are downwind of states that have not imposed similar controls. EPA's new rules will help address this inequity and they must be implemented as soon as possible.

Encouragingly, ongoing monitoring efforts in Massachusetts and other states indicate that mercury levels in fish and other biota have fallen as we have addressed our region's sources of mercury pollution. However, fish mercury levels from most water bodies still remain too high. Due to air transport and deposition, emissions from out-of-region sources, in particular coal-fired power plants, are now the largest contributors to our mercury pollution problem and must be reduced to protect our environment, the health of our children and to meet the objectives of the Clean Air and Clean Water Acts. Reducing power plant emissions will also improve environmental quality and public health not only in Massachusetts and New England but in all areas downwind of these facilities.

Subcategorization

MassDEP agrees with NACAA's comments on the flaws in EPA's creation of a sub-category for "coal-fired units designed to combust coal with heat content less than 8,300 Btu per pound" (the "lignite category").

Electronic reporting of MACT compliance information

EPA has proposed using the existing Emissions Collection and Monitoring Plan System (ECMPS) used by power plants for the federal Acid Rain Program (ARP) and Clean Air Interstate Rule (CAIR) to process and evaluate continuous monitoring data and other information in an electronic format submittal to EPA. MassDEP strongly supports use of this system as a transparent, streamlined approach to collecting

MACT compliance data that is available to regulators and the public, particularly for mercury data that will be available from Continuous Emissions Monitoring Systems (CEMS). The facilities that EPA proposes to regulate for MACT already report electronically to ECMPS. The addition of mercury to those pollutants already reported would be of benefit to EPA, states, the public and facilities, and be a

* * *

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www.neiwpcc.org

p: 978-323-7929
f: 978-323-7919

August 2, 2011

Air and Radiation Docket and Information Center
Environmental Protection Agency
Mail Code: 2822T
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: National Emission Standards for Hazardous Air Pollutants from Coal-Fired and Oil-Fired Electric Utility Steam Generating Units, Docket ID No. EPA-HQ-OAR-2009-0234

To whom it may concern:

The New England Interstate Water Pollution Control Commission (NEIWPCC), on behalf of its member states (Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and

Vermont), commends EPA on its effort to establish national emission standards for hazardous air pollutants from coal-fired and oil-fired electric utility steam generating units. We are pleased that EPA is taking the necessary steps to reduce pollution from these sources, which will have important positive impacts on human health and the environment. In particular, our interest lies in the control of mercury emissions from this sector.

For many years NEIWPCC has coordinated with its member states to devise an approach for addressing high levels of mercury in fish and water quality impairments that result from atmospheric deposition of mercury. The Northeast Regional Mercury Total Maximum Daily Load (TMDL), which was approved by EPA in December 2007, highlights the need for significant mercury emission reduction from both in-region and out-of-region sources. The Northeast States' Clean Water Act Section 319(g) Petition for Mercury was filed with EPA in October 2008 as a follow up to the TMDL and in June 2010 EPA convened the nation's firstever 319(g) management conference in response to the petition. The TMDL stipulates that in order to meet water quality standards in the Northeast states, anthropogenic atmospheric deposition of mercury must be reduced by 87 to 98 percent, which will necessitate large reductions from essentially all significant sources. A significant portion of the mercury currently being deposited in the Northeast originates from coal-fired power plants in states outside of our region. Therefore, establishing national emission standards for coal-fired electricity generation that would prevent 91 percent of the

mercury in coal from being released to the environment is a vital step in allowing us to meet our ultimate goal of making fish in the Northeast safe to eat.

The Northeast states all have aggressive mercury reduction programs in place. The six New England states are members of the New England Governors-Eastern Canadian Premiers Mercury Task Force and have been implementing the associated Mercury Action Plan (MAP) since 1998. The ultimate goal of the MAP is virtual elimination of all anthropogenic releases of mercury. New York State also supports the goals identified within the MAP, has a strong mercury reduction program, and has established its own Mercury Task Force to coordinate mercury issues within the state.

Through these programs, the Northeast states have implemented numerous mercury reduction activities such as stringent controls on municipal waste combustors and medical waste incinerators, comprehensive regulations and legislation related to mercury in products, and requirements for installation of dental amalgam separators. Specific to coal-fired power plants, the states where these types of facilities are located have already adopted stringent mercury control requirements for this sector and in many cases these requirements are more stringent than what EPA has proposed under this rule. Furthermore, because some of the states' rules have been in effect for a number of years, there are data available that demonstrate the affected units are achieving the required reductions. This is an indication that similar facilities elsewhere can be

successful in achieving significant mercury reductions with existing control technologies.

Due to the great need for mercury reductions not only in the Northeast, but nationwide, and evidence that stringent reductions can be achieved in this sector, we strongly encourage EPA to move forward with implementation of this proposed rule by the established deadline. It is essential that this step is taken to reduce the risk associated with mercury-contaminated fish in our waters and protect public health. Thank you for the opportunity to provide comments on this proposed rule. Please do not hesitate to contact me or Beth Card of my staff if you have any questions regarding our comments.

Sincerely,

Ronald Poltak

Ronald Poltak
Executive Director

Cc: NEIWPCC Executive Committee
NESCAUM Board of Directors

NESCAUM
Northeast States for Coordinated Air Use Management
89 South Street, Suite 602
Phone 617-259-2000
www.mescaum.org
Boston MA 02111
Fax 617-742-9162

August 2, 2011

Lisa P. Jackson, Administrator
U.S. Environmental Protection Agency
Air and Radiation Docket
Mail Code 2822T
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
Attention: Docket ID Nos. EPA–HQ–OAR–2009–0234 (NESHAP) and EPA–HQ–OAR–2011– 0044 (NSPS)

Re: *Proposed Rule – National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial- Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units*

Dear Administrator Jackson:

The Northeast States for Coordinated Air Use Management (NESCAUM) offer the following comments on the U.S. Environmental Protection Agency's (EPA's) proposal, published on May 3, 2011 in the Federal Register, entitled "National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-fired Electric Utility Steam Generating

Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units" (76 FR 24976-25147) (*hereinafter* "Utility MACT Rule"). NESCAUM is the regional association of air pollution control agencies representing Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

The proposed Utility MACT Rule reflects long standing requirements contained within the Clean Air Act that Congress adopted and charged EPA with the responsibility for implementing. While some have argued that the statutorily-required compliance timeline is too tight, power plant owners have been on notice of pending control requirements since late 2000 when EPA determined as part of a study required by the 1990 Clean Air Act Amendments that regulating mercury and other toxic air emissions from power plants was "appropriate and necessary."[1] The 2008 D.C. Circuit decision in *New Jersey v. EPA* (517 F.3d 574) vacating the earlier Clean Air Mercury Rule was another clear signal of the need to address hazardous air pollutants from power plants under § 112 of the Clean Air Act. As we describe later in these comments, a

[Page 2]
number of the NESCAUM states (and elsewhere) have already adopted state mercury rules for coal-

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[1] "Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units," 65 Fed. Reg. 79825 (December 20, 2000).

fired power plants, with controls in place at a growing number of units.[2]

As proposed, the Utility MACT Rule will have public health and environmental benefits that far exceed its projected costs. In the regulatory impact analysis for the proposed rule, EPA estimated monetized benefits associated with reductions in mercury and particulate matter (used as the surrogate for non-mercury toxic metals) in the range of $53-140 billion in 2016, with projected costs of $10.9 billion (2007$).[3] EPA did not quantify benefits for a number of health and welfare end points, such as those associated with reductions in non-mercury hazardous air pollutants. As a result, the monetized benefits are a lower bound of the potential benefits resulting from reductions of the full suite of air toxics under the proposed rule. Therefore, as we discuss further in our detailed comments, we urge EPA to move expeditiously to finalize these standards so that the public health and welfare benefits begin to accrue as soon as possible.

I. Previous NESCAUM Comments on Clean Air Mercury Rule (CAMR)

In commenting in 2004 on the proposed Clean Air Mercury Rule (CAMR), the vacated predecessor of

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[2] National Association of Clean Air Agencies (NACAA), "State/Local Mercury/Toxics Programs for Utilities," April 6, 2010, available at http://www.4cleanair.org/Documents/StateTableupdatedApril2010.doc (accessed January 18, 2011).

[3] U.S. EPA, *Regulatory Impact Analysis for proposed Toxics Rule (the Utility MACT and NSPS proposals)*, U.S. EPA, March 16, 2011. Available at http://www.epa.gov/ttn/ecas/ria.html (accessed March 16, 2011).

the proposed Utility MACT rule, NESCAUM expressed four specific concerns: (1) EPA's maximum achievable control technology (MACT) floor determination was flawed; (2) EPA's proposed trading schemes under either Clean Air Act § 111 or § 112 were illegal and bad public health policy; (3) EPA needed to consider other hazardous air pollutants (HAPs) in the proposed regulation in addition to mercury; and (4) despite EPA's claims to the contrary at that time, control technologies were commercially available to substantially reduce mercury emissions from electric generating units (EGUs).[4]

NESCAUM is pleased to see that EPA's proposed Utility MACT Rule now seeks to address all four of these concerns in a more constructive manner that is better aligned with the statutory language of the Clean Air Act and sound public health policy. The NESCAUM states agree with EPA's December 2000 finding that regulating HAP emissions from EGUs under Clean Air Act § 112 is "appropriate and necessary," agree with EPA's current confirmation of the December 2000 finding, and agree with EPA that its subsequent reversal of this finding in 2005 was in error.

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[4] NESCAUM comments to EPA on *Proposed National Emission Standards for Hazardous Air Pollutants; and in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units* (69 FR 4652-4752), submitted June 29, 2004 (available at http://www.nescaum.org/documents/proposed-national-emission-standards-for-hazardous-air-pollutants/).

[Page 3]

II. Public Health Concerns

a. Mercury problem in Northeast

Mercury is a health and environmental issue for the NESCAUM states. Mercury deposition from upwind sources has significantly affected aquatic and terrestrial environments in the Northeast, resulting in states having to issue fish consumption advisories to protect human health.

Over 15,000 fish samples collected in the Northeast confirm widespread mercury contamination of our aquatic ecosystems, threatening human health and wildlife unless actions are taken to reduce significant local and upwind sources of mercury emissions. Mercury contamination threatens the tourist and recreational fishing industries, which contribute $3 billion a year to our regional economy. Pursuant to the federal Clean Water Act, all the NESCAUM states have established EPA-approved total maximum daily loads (TMDLs) for mercury entering the waters of the Northeast.[5]

Historically, the NESCAUM states have adopted more stringent mercury controls on air pollution sources, and in advance of national requirements. These have included limits on municipal waste combustors and medical waste incinerators. As

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[5] EPA Region 1 letter to CT DEP, *Notification of Approval of Northeast Mercury TMDL*, December 20, 2007; EPA Region 2 letter to NJ DEP, *Review of Total Maximum Daily Load (TMDL) for Mercury Impairments Caused Mainly by Air Deposition in 122 HUC 14s Statewide, New Jersey (NJ)*, September 25, 2009.

described later in these comments, the NESCAUM states with coal-fired EGUs have already adopted state rules that limit mercury emissions from these power plants at levels that are comparable to, and in many cases more stringent than, the mercury limits in EPA's proposed mercury standards.[6]

In addition to air releases, the Northeast states have also implemented programs that reduce mercury releases to water and waste streams, such as use of dental amalgam separators and restrictions on the sale and disposal of mercury-added products (e.g., automotive light switches, thermometers, thermostats).[7] These efforts have had positive results. Reductions in mercury releases in the Northeast have been correlated with reductions in mercury concentrations in fish

[Page 4]
tissue in a number of Northeast water bodies[8,9] and in the effluent discharged from municipal wastewater treatment plants.[10]

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[6] Connecticut General Statutes (CGS) section 22a-199; Massachusetts adopted rule 310 CMR 7.29; New Hampshire Revised Statutes Annotated (RSA) Chapter 125-O; New Jersey Statutes Annotated (NJSA) 7:27-27; New York Codes, Rules and Regulations (NYCRR) Part 246.

[7] King, S., P. Miller, T. Goldberg, J. Graham, S. Hochbrunn, A. Wienert, and M. Wilcox. 2008. Reducing Mercury in the Northeast United States. *EM*, Air & Waste Management Association (Pittsburgh, PA), pp. 9-13 (May 2008).

[8] Massachusetts Department of Environmental Protection (MassDEP). "Massachusetts fish tissue mercury studies: Long-term monitoring results, 1999-2004." MassDEP Office of

Despite these successful measures, transported mercury emissions from out-of-region coal-fired EGUs are a major contributor to mercury deposition in the Northeast. Based on an EPAsponsored modeling analysis,[11] NESCAUM concluded that much of the mercury entering the Northeast's aquatic ecosystems is deposited from the air, and a significant portion of this mercury comes from emission sources outside the NESCAUM region.[12] As part of a Clean Water Act sec. 319(g) conference that focused on water quality impairment issues identified in the Northeast Regional Mercury TMDL,

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Research and Standards, Boston. MA and Wall Experiment Station, Lawrence, MA (2006).

[9] Evers, D.C., Y.-J. Han, C.T. Driscoll, N.C. Kamman, M.W. Goodale, K.F. Lambert, T.M. Holsen, C.Y. Chen, T.A. Clair, and T. Butler. 2007. Biological mercury hotspots in the northeastern United States and southeastern Canada. *BioScience* 57: 29-43.

[10] King, S., P. Miller, T. Goldberg, J. Graham, S. Hochbrunn, A. Wienert, and M. Wilcox. 2008. Reducing Mercury in the Northeast United States. *EM*, Air & Waste Management Association (Pittsburgh, PA), pp. 9-13 (May 2008).

[11] U.S. EPA. "Model-based Analysis and Tracking of Airborne Mercury Emissions to Assist in Watershed Planning." Final Report, U.S. EPA Office of Wetlands, Oceans, and Watersheds, Washington, DC (August 2008), http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/final300report_10072008.pdf (accessed June 11, 2011).

[12] Northeast States for Coordinated Air Use Management (NESCAUM). "Sources of Mercury Deposition in the Northeast United States." NESCAUM, Boston, MA (March 2008), http://www.nescaum.org/documents/nescaumsources-of-hg-depo-in-northeast_2008-final.pdf/.

EPA reviewed NESCAUM's analysis and found its results virtually identical with EPA's own analysis.[13]

In order for the northeast states to achieve their mercury TMDL targets, mercury deposited from the air may need to be reduced in the range of 87 to 98 percent.[14] In view of the public health and environmental impacts associated with exposure to mercury, and the contributions of longrange transport of mercury from sources outside the NESCAUM region, it is extremely important that the EPA take swift, aggressive, and comprehensive steps to reduce mercury emissions from EGUs and other air emission sources.

b. Non-mercury air toxics health concerns

The NESCAUM states are pleased to see that EPA's proposal now includes non-mercury air toxics, which were missing from the 2004 CAMR proposal. EGUs release many more air toxics than just mercury, and comprehensive protection of public health requires a wider net be cast to address the many different HAPs emitted by these sources.

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[13] U.S. EPA. "Determination of Mercury Deposition Contributions from States Outside the Northeast." Presentation by Dwight Atkinson, U.S. EPA, at Clean Water Act Section 319(g) Mercury Conference, Philadelphia, PA, June 22-23, 2010.

[14] New England Interstate Water Pollution Control Commission (NEIWPCC). "Northeast Regional Mercury Total Maximum Daily Load." NEIWPCC, Lowell, MA (submitted to U.S. EPA on October 24, 2007; approved by U.S. EPA on December 20, 2007).

[Page 5]
A suite of non-mercury toxic metals have attributes known to harm public health. For example, researchers have implicated nickel emissions from oil combustion with an increased risk in daily mortality.[15] In the Northeast, EGUs burning No. 6 residual oil are a large source of these emissions. EPA provides a good summary in its proposal of the cancer and non-cancer impacts for the non-mercury toxic metals, acid gases, and organic HAPs, including dioxins/furans. This is a compelling health basis for moving forward with standards and measures aimed at this broader set of HAPs.

III. Mercury

a. Proposed mercury MACT standard

We appreciate the transparency EPA has provided in making available the stack test data and explaining its variability methodology. We have reviewed this information, and as we will explain in more detail below in our comments on variability, we believe there is a sound basis to establish a MACT floor within a lower range than what EPA is proposing.

EPA initially proposed a mercury MACT limit of 1.0 pounds per trillion British thermal units fuel input (lb/TBtu) for existing coal-fired units designed for coal ≥ 8,300 Btu/lb, which it has now adjusted to 1.2 lb/TBtu due to identified earlier discrepancies in

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[15] Lippmann, M., K. Ito, J.S. Hwang, P. Maciejczyk, and L.C. Chen. 2006. Cardiovascular Effects of Nickel in Ambient Air. *Environ. Health Perspect.* 114(11): 1662-1669.

recalculating historical mercury emissions data.[16] Notwithstanding the previously cited data discrepancies, our review of the data set and the variability analysis used by EPA indicates that a realistic MACT floor for mercury emissions from these types of units should be recalculated taking our review of the data into account. We also note that some individual member states of NESCAUM will be submitting separate comments on their states' behalf with additional recommendations for mercury MACT limits based on their re-analysis of the EPA data set.

b. NESCAUM states have already successfully implemented mercury limits for coal power plants that are more stringent than EPA's proposed mercury standards

A number of NESCAUM states with large coal-fired power plants have already adopted stringent mercury control requirements for these facilities that are, in most cases, more stringent than those of EPA's proposed mercury standards. Some provisions of the states' rules have now been in effect for several years, and compliance data indicate that the affected units are achieving the required mercury reductions. This successful experience is a harbinger of the ability of coal units elsewhere to achieve significant mercury reductions with existing control technologies. Below are brief summaries of NESCAUM state rules and experience in controlling mercury from coal-fired EGUs. The accompanying Attachments A and B provide tables summarizing

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[16] Letter from U.S. EPA Assistant Administrator Gina McCarthy, Office of Air and Radiation, to Lee B. Zeugin, Hunton & Williams, Counsel to the Utility Air Regulatory Group, May 18, 2011.

the state mercury rules and the controls installed or planned at coal power plants in the NESCAUM region to comply with the state rules.

[Page 6]
Connecticut
Under Connecticut General Statute section 22a-199, adopted in 2003, coal-fired EGUs in Connecticut had to achieve by July 1, 2008 a mercury emissions limit of 0.6 lbs/TBtu or a rate equivalent to a 90 percent reduction from measured inlet conditions.

Of the three affected Connecticut units, the Bridgeport unit installed activated carbon injection (ACI) with a pulse-jet fabric filter baghouse to achieve mercury reductions. The AES Thames units are circulating fluidized bed boilers with dry limestone injection and fabric filtration to control sulfur, and were able to meet the state limits without installing mercury-specific controls.

Quarterly stack testing of the three affected units in Connecticut (PSEG Bridgeport Harbor unit 3, AES Thames units 1 and 2) indicated that they achieved the state's mercury requirements.[17]

Massachusetts
In 2001, as part of a multi-pollutant regulation controlling sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury, Massachusetts established annual mercury emission caps for the state's coal-fired power plants at the then-current level of emissions. To reduce emissions, in 2004,

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[17] AES Thames units 1 and 2 have been shut down since January 2011, but were in compliance when operating.

Massachusetts revised its state rule (310 CMR 7.29) to require specific mercury emission limits at the state's coal-fired EGUs in two phases. Phase 1 required a minimum 85 percent mercury capture as compared to 2001-2002 inlet emissions or a maximum emission rate of 0.0075 lb/GWh by January 1, 2008, and required continuous monitoring of mercury emissions by the same date. Phase 2 requires a minimum of 95 percent mercury capture as compared to 2001- 2002 inlet emissions or a maximum emission rate of 0.0025 lb/GWh by October 1, 2012. The rule allows averaging between units at the same power plant.

Of the eight EGUs subject to Phase 1 of Massachusetts' rule, one unit (Somerset) has shut down, three units (Salem Harbor) did not need to install mercury controls because they could meet the Phase 1 standard without additional controls and have announced they will shut down, and one unit (Mt. Tom) installed selective catalytic reduction (SCR), a dry scrubber (DS) and a fabric filter. At Brayton Point, unit 1 installed SCR, dry sorbent injection (DSI), spray dryer absorption (SDA), and a fabric filter (FF), unit 2 installed DSI-SDA-FF, and unit 3 installed SCR and has DSI-DS-FF under construction.

The affected units have continuous emission monitoring systems (CEMS) or sorbent trap data to determine compliance with the state's regulation. The compliance reports submitted in January 2011 show mercury compliance for 2010 at all operating units.

New Hampshire

New Hampshire has adopted state legislation (RSA 125-O:11-18) calling for a state-wide 80 percent reduction in coal-fired power plant mercury emissions through installation of wet flue gas desulfurization technology ("wet scrubber") at the Public Service of New Hampshire Merrimack Station no later than July 1, 2013. A power plant can earn sulfur dioxide emission credits for early mercury reductions prior to the 2013 deadline. The state law applies to Merrimack units 1 and 2 and Schiller units 4, 5, and 6. It does not allow the purchase of mercury credits or allowances to meet compliance, nor does it allow the sale of credits or allowances generated through mercury reductions at a unit as a result of the state's law.

New Jersey

New Jersey's 2004 state rule (N.J.A.C. 7:27-27.1 *et seq.*) requires coal-fired units of any size in the state to achieve a mercury control efficiency of 90 percent or a mercury emission limit of 3.00 mg/MWh by December 15, 2007. New Jersey also provides for a multi-pollutant approach to reduce nitrogen oxides, sulfur dioxide, and fine particulates that can extend a unit's mercury compliance deadline to December 15, 2012 if approximately 50 percent of a company's coalfired capacity in the state meets the mercury limits by the 2007 deadline.

Ten units were covered by New Jersey's mercury rule at the time it was adopted in 2004. Coal units are using ACI to meet the rule requirements, and stack testing indicates the applicable limits are being met.

New York

In January 2007, New York enacted a rule (6 NYCRR Part 246) for the control of mercury emissions from coal-fired EGUs that incorporates a Phase I facility-wide emission cap in the years 2010-2014 and establishes a unit-based emission limit for each applicable unit beginning in 2015. The facility-wide cap does not allow affected power plants to generate and trade mercury reductions with other facilities in-state or out-of-state. Phase I of the rule imposes annual facility-wide mercury emission limitations, based upon the state mercury budget EPA distributed to New York under the vacated Clean Air Mercury Rule. The annual facility-wide emission limitations will be in effect from 2010 to 2014. Starting in 2015, in conjunction with other electric sector regulations such as the Regional Greenhouse Gas Initiative (RGGI) and EPA's previously enacted Clean Air Interstate Rule, now re-promulgated as the Cross-State Air Pollution Rule, state mercury regulation will establish a facility-wide mercury emission limit of 0.6 lb/TBtu.

Compliance with the state's Phase I limits have been met with sulfur reduction technologies that have co-benefits in reducing mercury. These include the following; 1) the installation of SCRFF on three EGUs; 2) previously installed SDA-FF at five EGUs prior to the regulation effective date of January 31, 2007; and 3) electrostatic precipitators (ESPs) at two EGUs. No facilities are yet using ACI until they need to meet the more stringent 0.6 lb/TBtu mercury limit in 2015 on a daily average. Electric generating units with nitrogen oxides and sulfur dioxide control in

New York are achieving mercury emission rates in the 0.6 lb/TBtu range and will use ACI to achieve

[Page 8]
consistent emission levels. Currently, all operating coal-fired EGUs in New York State are meeting the Phase I facility-wide caps.

c. Mercury control options are commercially available and demonstrated to work

As is evident from the experience in the NESCAUM states, there are a number of technology approaches available to meet mercury reduction requirements for coal-fired power plants. Because the NESCAUM states took early action, they have established an operational track record demonstrating the ability of these technologies to meet the mercury standards in EPA's proposed rule.

Based on a recent assessment of power plant control technologies prepared for NESCAUM, about 25 units representing approximately 7,500 MW are presently using commercial ACI technologies for mercury control.[18] (The NESCAUM assessment is included as part of these comments). In addition, as of June 2010, about 55,000 MW of new ACI bookings are reported by the Institute of Clean Air Companies (ICAC), a national association of companies

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[18] J. Staudt (Andover Technology Partners) and M.J. Bradley & Associates. "Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants." Report prepared for NESCAUM, Boston, MA (March 31, 2011), http://www.nescaum.org/documents/coal-control-technology-nescaum-report-20110330.pdf/.

providing pollution control systems for power plants and other stationary sources.[19]

In addition, as seen by state experience in the NESCAUM region, mercury can be captured to some degree by existing air pollution controls, and, in many cases, technologies to control one pollutant have the co-benefit of also controlling other pollutants. For example, scrubbers, which are designed to control sulfur dioxide, are also reducing emissions of mercury (as well as particulate matter, other toxic metals, and acid gases).

In NESCAUM's assessment of power plant control technologies, we identified a number of control options that directly targeted mercury for control or had the co-benefit of reducing mercury when targeting other air pollutants. Activated carbon injection can be installed to directly target mercury, while the following options reduce mercury as a co-benefit: combustion controls, selective catalytic reduction, electrostatic precipitators, baghouses, dry and wet scrubbers, and dry sorbent injection.

d. Subcategories of coal types based on calorific content

The NESCAUM states agree with previous testimony provided to EPA at the May 24 Chicago hearing by the National Association of Clean Air Agencies (NACAA) that there is weak support for a separate subcategory called "coal-fired units

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[19] Institute of Clean Air Companies (ICAC). "Commercial Bookings List." June 2010, http://www.icac.com/files/members/Commercial_Hg_Bookings_060410.pdf (accessed February 1, 2011).

designed to combust coal with a heat content less than 8300 Btu/lb." As the NACAA testimony indicated, "there are 30 sources within this proposed subcategory and slightly over 1061 units in the large category of coal-fired units (for mercury). The rationale put forward in the proposal for establishing the proposed mercury

[Page 9]
subcategory is that no unit meeting this definition was within the top 12 percent of performing sources in the larger category. Even if it were permissible to establish subcategories based on emission test results, absent an engineering basis for doing so, the EPA test data does not appear to support a separate subcategory in this instance."[20]

IV. Non-mercury Metal HAPs

a. Proposed non-mercury metal HAPs MACT standards

The NESCAUM states support the proposed MACT standards for non-mercury metal HAPs, with the caveat that EPA should follow conventional rounding rules to establish the standards. For present purposes, the NESCAUM states also support using total particulate matter (PM) as the surrogate for

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[20] National Association of Clean Air Agencies (NACAA), Testimony presented by David Shaw, NACAA Co-President and Director of the New York Division of Air Resources, at the EPA hearing on *Proposals for National Emission Standards for Hazardous Air Pollutants from Coal and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional and Small Industrial-Commercial-Institutional Steam Generating Units*, Chicago, IL (May 24, 2011).

non-mercury metal HAP emissions. This is based on the premise that most if not all non-mercury HAP metals are entrained in the flue gas fly-ash such that effective PM controls will also effectively capture the non-mercury metal HAP constituents within the total PM. We recognize, however, that smaller size particulate matter (e.g., $PM_{2.5}$) may be a better indicator due to preferential partitioning of non-mercury metal HAPs in the smaller size fractions of total PM. As EPA indicates, test methods for $PM_{2.5}$ in flue-gas are not applicable to all exhaust stack conditions. For the future, we encourage EPA to develop more broadly applicable $PM_{2.5}$ stack test methods that can replace total PM as the non-mercury metal HAP surrogate, to the extent feasible.

b. Non-mercury metal HAPs control options are commercially available and demonstrated to work

As described in the accompanying control technology assessment, there are readily available control technologies for reducing total PM; hence, non-mercury metal HAPs, emitted by coalfired EGUs. These technologies include electrostatic precipitators and baghouses (fabric filters). The electric power sector has an established history in installing and operating these types of controls. For example, more than 300 existing coal-fired power plants are reported to have installed ESPs and/or baghouses.[21]

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[21] Environmental Health and Engineering, Inc. "Emissions of Hazardous Air Pollutants from Coal-fired Power Plants." Needham, MA (March 7, 2011), http://www.lungusa.org/assets/documents/healthy-air/coal-fired-planthazards.pdf, Table 6 (accessed May 18, 2011).

V. Acid Gas HAPs

a. Proposed acid gas HAP MACT standards

The NESCAUM states support proposed acid gas HAP MACT standards that have the potential of reducing acid gas emissions from EGUs by over 90 percent, with the caveat that EPA should

[Page 10]
follow conventional rounding rules to establish the standards. The NESCAUM states also support using hydrogen chloride (HCl) as the surrogate indicator for acid gas HAPs in a technology-based MACT standard.

With regard to using sulfur dioxide (SO_2) as the alternative equivalent acid gas surrogate to HCl for units with SO_2 scrubbers, the NESCAUM states provide qualified support to the extent it is clear that the projected SO_2 reductions associated with meeting the acid gas HAP MACT limit are not, by extension, considered an adequate level of control for SO_2 under all settings. The NESCAUM states recognize that because SO_2 is a criteria air pollutant, and not a HAP, the use of SO_2 as an alternative surrogate under Clean Air Act § 112 is solely for purposes of regulating HAPs and not for direct regulation of SO_2 *per se*. Greater reductions in SO_2 emissions are achievable with existing technologies than EPA assumes would occur to achieve a greater than 90 percent reduction in acid gas HAP emissions. Additional SO_2 reductions from EGUs may be necessary, for example, to achieve SO_2 and $PM_{2.5}$ national ambient air quality standards. Therefore, the SO_2 reductions occurring as a result of its use as an alternative surrogate for acid gas HAP MACT

standards should not be considered an indicator of maximum achievable SO_2 reductions from EGUs for purposes of meeting national ambient air quality standards.

b. Acid gas HAPs control options are commercially available and demonstrated to work

For EGUs with wet or dry scrubbers for SO_2 control (installed at about 200 U.S. coal power plants),[22] these controls will likely provide the co-benefit of HCl capture for meeting the proposed acid gas MACT standard. For those units that are unscrubbed, other technology options exist in addition to scrubbers. For example, unscrubbed EGUs could be retrofit with dry sorbent injection (DSI) systems and fabric filters that are relatively inexpensive in capital cost, especially for smaller EGUs (<250 MW). They can also be simpler to install compared to scrubbers, with typical installation times within 12 months. While DSI units have been demonstrated to achieve HCl capture rates well above 90 percent, SO_2 removal is typically more modest compared to scrubber technologies (see attached NESCAUM report on control technologies for coal-fired power plants). DSI controls have not been as widely installed as other EGU control technology options, but there are a growing number of power plants with installed DSI and operating experience that demonstrate DSI's ability to significantly reduce acid gas HAP emissions.[23]

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[22] Environmental Health and Engineering, Inc., Table 6.

[23] Kong, Y. and M. Wood. 2011. Dry Injection of Sodium Sorbents for Air Pollution Control. *Environ. Engineer* 47: 20-23.

VI. Work Practice Standards for Organic HAPs, Including Dioxins and Furans

The NESCAUM states agree that work practice standards are appropriate for addressing organic HAPs, including dioxins and furans, in lieu of numerical MACT standards. Concentrations of these HAPs in EGU stack flue-gases are often below instrumental minimum detection limits,

* * *

[Page A-1] Attachment A
NESCAUM State Mercury Programs for Coal Power Plants[1]

State	Control Program	Monitoring Requirements
Connecticut	Emissions from coal-fired electric generating units (EGUs) are limited to 0.6 lbs Hg/TBtu or a 90% reduction pursuant to Connecticut General Statutes section 22a-199. The owner or operator of any coal-fired EGU is required to apply for and obtain a new source review permit pursuant to section 22a-174-3a(n) of the Regulations of Connecticut State Agencies.	Compliance is determined through quarterly stack testing.
Massachusetts	Adopted rule 310 CMR 7.29. In 2001, as part of a multi-pollutant regulation controlling sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury, Massachusetts initially established annual mercury emission caps for the state's coal-fired power plants at the then-current level of emissions. To reduce emissions, a 2- phase mercury reduction program was established in 2004. Phase 1 required a minimum 85% capture as compared to 2001-2002 inlet emissions or a maximum 0.0075 lb/GWh rate by 1/1/2008. Phase 2 requires a minimum 95% capture as compared to 2001- 2002 inlet emissions or a maximum 0.0025 lb/GWh rate by 10/1/2012. Averaging between units at the same facility is allowed.	Required continuous Hg monitoring by 1/1/2008.
New Hampshire	RSA Chapter 125-O Multiple Pollutant Reduction Program requires reductions in mercury and other pollutants from coal- burning EGUs (Merrimack 1 and 2 and Schiller 4, 5, and 6) by 2013. This statute requires installation of a wet FGD system (scrubber) at Merrimack 1 and 2 to control mercury emissions at the maximum sustainable rate by July 1, 2013. For all affected units, the aggregated total annual reduction in mercury emissions shall be a minimum of 80 percent below the baseline mercury input.	Annual baseline Hg input determined by monthly samples of coal used at affected units. A minimum of four stack tests at affected units used to determine annual baseline Hg emissions. After baseline emissions determined, stack tests twice a year used to determine emissions performance. CEMS required to be installed when federal performance specification takes effect.

[1] Extracted from information compiled by the National Association of Clean Air Agencies (NACAA), February 2011, and updated by the NESCAUM states in May 2011.

[Page A-2]

State	Control Program	Monitoring Requirements
New Jersey	Adopted state rule under NJSA 7:27-27 requires control efficiency of 90% or 3 mg/MWh by 12/15/2007 for coal-fired boilers of any size. A multi-pollutant approach can reduce the initial reduction required and extend compliance to 12/15/2012.	Stack testing used for compliance purposes. Hg CEMS are installed at three units but are not QA/QC'd and not used for determining compliance.
New York	On 1/27/07, NYSDEC promulgated 6NYCRR Part 246 for the control of mercury emissions from coal-fired electric utility steam generating units that incorporates a Phase I emission cap in the years 2010-2014 and beginning in 2015 establishes a unit-based emission limit for each applicable unit. Phase I of the state proposal imposed annual facility-wide mercury emission limitations, based upon the state mercury budget EPA distributed to NY under the vacated CAMR. The annual facility- wide emission limitations will be in effect from 2010 to 2014. Starting in 2015, Phase II, in conjunction with other electric sector regulations such as the Regional Greenhouse Gas Initiative (RGGI) and EPA's Cross-State Air Pollution Rule, the state mercury regulation will establish a facility-wide emission limit for Hg 0.6 lbs Hg/TBtu.	Annual stack testing was required for the years 2008 and 2009. Hg CEMS have been installed and operating since 2009. New York has three facilities operating CEMS and two facilities using sorbent tube methodology.

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In the Supreme Court of the United States

MICHIGAN, ET AL., PETITIONERS
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

UTILITY AIR REGULATORY GROUP, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

NATIONAL MINING ASSOCIATION, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

ON WRITS OF CERTIORARI
TO THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

JOINT APPENDIX – VOLUME 2 OF 4

Donald B. Verrilli, Jr.
Solicitor General
Counsel of Record
Department of Justice
Washington, D.C.
20530-0001
SupremeCtBriefs@usdoj.gov
(202) 514-2217

Aaron D. Lindstrom
Solicitor General
Counsel of Record
P.O. Box 30212
Lansing, Michigan 48909
LindstromA@michigan.gov
(517) 373-1124

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Writs of Certiorari Granted November 25, 2014

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Melissa Hoffer
Counsel of Record
Assistant Attorney General
Environmental Protection Division
One Ashburton Place
18th Floor
Boston, MA 02130
melissa.hoffer@state.ma.us
(617) 963-2322

Brendan K. Collins
Counsel of Record
Ballard Spahr LLP
1735 Market Street
51st Floor
Philadelphia, PA 19103
collins@ballardspahr.com
(215) 665-8500

Sean H. Donahue
Counsel of Record
Donahue & Goldberg LLP
1130 Connecticut Ave., NW
Suite 950
Washington, D.C. 20036
sean@donahuegoldberg.com
(202) 277-7085

F. William Brownell
Counsel of Record
Hunton & Williams LLP
2200 Pennsylvania Ave., NW
Washington, D.C. 20037
bbrownell@hunton.com
(202) 955-1500

Peter S. Glaser
Counsel of Record
Troutman Sanders LLP
401 Ninth Street, NW
Suite 1000
Washington, D.C. 20004
Peter.glaser@troutmansanders.com
(202) 274-2998

TABLE OF CONTENTS

VOLUME 1 OF 4

Relevant Docket Entries
White Stallion Energy Center v. *EPA*
Court of Appeals
Docket No. 12-1100 1–26

U.S. EPA, Mercury Study Report to Congress,
Vol. 1: Executive Summary, EPA-452/R-97-003
Docket No. EPA-HQ-OAR-2009-0234-3054
December 1997

Excerpts

Overview [pp. O-1 to O-4] 27–35

Report to Congress [pp. 1-1 to 1-3] 36–43

[pp. 4-1 to 4-10] 44–60

EPA Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress, Volume 1
Docket No. EPA-HQ-OAR-2009-0234-3052
February 1998

Excerpts

Executive Summary
[pp. ES-1 to ES-29] 61–114

Utility Study Section 2.7 [p. 2-25] 115–116

Title I and Title IV,
Phase I and Phase II,
Compliance Strategy Impact
[pp. 2-31 to 2-32] 117–119

6.0 Inhalation Risk Assessment
[pp. 6-1 to 6-7] 120–131

Table 7-1 [pp. 7-8] 132–134

Areas for Further Research and Analysis
[pp. 14-8 to 14-10] 135–138

69 Fed. Reg. 4652
January 30, 2004
[pp. 4657 to 4659] 139–145

70 Fed. Reg. 15994
March 29, 2005
Sections F & G
[pp. 16019 to 16022] 146–162

Coal-to-Gas Conversion TSD,
EPA-HQ-OAR-2009-0234-3065
March 4, 2011 163–166

Memo, "National Emission Standards for Hazardous Air Pollutants (NESHAP) Beyond the Maximum Achievable Control Technology (MACT) Floor Analysis for Coal- and Oil-fired Electric Utility Steam Generating EGUs"
EPA-HQ-OAR-2009-0234-2924
March 14, 2011 167–179

National Mining Association's Comments
Docket No. EPA-HQ-2009-0234 (NESHAP action) and EPA-HQ-OAR-2011-0044 (NSPS)
76 Federal Register 24,976
May 3, 2011
Excerpt
[pp. 26 to 27] 180–185

Connecticut Department of Energy and Environmental Protection comments
EPA-HQ-OAR-2009-0234-20298
July 12, 2011
Excerpts
Cover letter and attachment
[pp. 1 to 2] 186–193

South Carolina Department of Health and Environmental Control comments
EPA-HQ-OAR-2011-0444-5749
July 20, 2011 194–213

Massachusetts Department of Environmental Protection comments
EPA-HQ-OAR-2009-0234-18039
July 29, 2011

Excerpts

[pp. 1 to 4] 214–218

[pp. 6 to 7] 219–227

New England Interstate Water Pollution Control Commission comments
EPA-HQ-OAR-2009-0234-17625
August 2, 2011 228–231

Northeast States for Coordinated Air Use Management comments
EPA-HQ-OAR-2009-0234-17843
August 2, 2011

Excerpts

[pp. 1 to 10] 232–252

Attachment A (table) [pp. A-1 to A-2] ... 253–254

VOLUME 2 OF 4

Michigan Department of Environmental Quality comments, EPA-HQ-0234-2009-0234-18426
August 3, 2011 255–277

National Association of Clean Air Agencies comments, EPA-HQOAR-2009-0234-17620
August 4, 2011

Excerpts

Cover letter and comments [pp. 1 to 10] 278–305

Attachment 1 (table) [pp. 1 to 15] 306–320

New Jersey Department of Environmental Protection, comments EPAHQ-OAR-2009-0234-18444
August 4, 2011

Excerpts

[pp. 1 to 2] 321–323

[pp. 4 to 5] 324–327

[pp. 9 to 10] 328–329

Comments of Environmental and Public Health Groups on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule. Docket No. EPA-HQ-OAR-2011-0044-5715
August 4, 2011

Excerpt

Chapter I [pp. I-1 to I-38] 330–382

Comments of Environmental Defense Fund on the National Emission Standards for Hazardous Air Pollutants From Coal-and Oil-Fired Electric Utility Steam Generating Units, Docket No. EPA-HQ-OAR-2009-0234-18421
August 4, 2011

Excerpt

Part I [pp. 3 to 7] 383–392

EPRI Comments on Proposed HAPs MACT Rule
EPA-HQ-2009-0234-17621
August 4, 2011

Excerpts

Specific Comments on the Environmental Fate and Transport, Exposure and Human Health Issues, and Risk Analyses [p. viii to x] 393–399

EPRI's comprehensive sector-wide inhalation risk assessment on all 470 coal-fired generating facilities identified no cancer or non-cancer health risks above regulatory risk threshold, in contrast to EPA's 16 case studies assessment
[pp. 3-22 to 3-27] 399–411

[pp. 3-46 to 3-48] 412–418

[pp. 3-53 to 3-56] 419–422

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17648, Part 1 of 3
August 4, 2011

Excerpts

Comment 1, Sections 1.1 through 1.2
[pp. 6 to 12] 423–436

Comment 2, Sections 2.1 through 2.3
[pp. 21 to 38] 436–468

Comment 3, entire
[pp. 38 to 53] 468–497

Comment 4, entire
[pp. 54 to 56] 497–503

Comment 5
[pp. 56 to 71] 503–532

Comment 7, Section 7.5
[pp. 88 to 90] 532–536

Comment 7, Section 7.7
[pp. 92 to 94] 536–539

Exhibit 2, MJ Bradley & Associates LLC and Analysis Group, "Ensuring a Clean, Modern, Electric Generating Fleet while Maintaining Electric System Reliability" (Aug. 2010) – Entire report, no attachments [pp. 1 to 24] 540–590

Exhibit 4, NESCAUM Report, "Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants" (Mar. 31, 2011) – Executive Summary
[pp. 1 to 4] 591–600

Exhibit 7, URS Report – Entire report, no appendices
[pp. 1 to 15] 601–624

VOLUME 3 OF 4

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule
Docket No. EPA-HQ-OAR-2009-0234-17651
Part 2 of 3
August 4, 2011

Excerpts

Exhibit 10, MJ Bradley Report Update – Entire report [pp. 1 to 20] 625–665

Exhibit 11, Tierney and Cicchetti Peer Review of EEI Report – Entire report [pp. 1 to 13] 666–685

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17650, Part 3 of 3
August 4, 2011

Excerpts

Exhibit 21 – Cicchetti Report – Entire report [pp. 1 to 50] 686–754

Exhibit 23 – Environmental Health & Engineering Inc. Report – Executive Summary and Sections 1.0 to 3.3 [pp. 1 to 22] 755–796

VOLUME 4 OF 4

New York Department of Environmental Conservation comments,
EPA-HQ-OAR-2009-0234-17796
August 4, 2011

Excerpts

Cover letter 797–801

Enclosure A [pp. 1 to 2] 802–806

==========

Comments of the Utility Air Regulartory Group
August 4, 2011

Excerpts

Attachment 15 [pp. 6, 12, 15, 16] 807–810

==========

Letter from Dr. Deborah Swackhamer and Dr. Stephen Roberts, Science Advisory Board to Lisa Jackson, Administrator, U.S. EPA,
EPA-OAR-2009-0234-18487 – Text only
Sept. 29, 2011 811–814

==========

Supplement to the Non-Hg Case Study Chronic Inhalation Risk Assessment In Support of the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units
EPA-HQ-OAR-2009-0234-19912
November 2011

Excerpts

3. Chronic Inhalation Risk Assessment
[p. 10 to 12] 815–817

3. Results [p. 12] 818

Table 9 [p. 13] 819–820

Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard, EPA-454/R-11-014
November 2011

Excerpts

All title pages and text pages
[pp. 1 to 3] 821–829

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 1 of 2
December 2011

Excerpts

Response to comment 25 [p. 13] 830

2. Consideration of both public health and environmental effects [pp. 23 to 29] 831–847

a. Agreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [p. 39] 847

b. Disagreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [pp. 39 to 41] 847–853

c. Agreement that EGUs were properly listed under CAA section 112(c)(1) and may not be delisted because they do not meet the delisting criteria in CAA section 112(c)(9). [pp. 52 to 54] 853–858

9. Consideration of criteria pollutants under Appropriate and Necessary Finding [pp. 55 to 59] 858–867

Response to comments 1 – 3 [p. 77] 867–869

Comment 9 and Response [pp. 79 to 81] 869–874

Response to Comment 30 [pp. 435] 874–875

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 2 of 2
December 2011

Excerpts

Response to Comments 49-50
[p. 322] 876–877

Response to Comments 52-62
[pp. 328-331] 878–884

Impacts and Costs Analysis, Comment 1 and response [p. 477] 885

Impacts and Costs Analysis, Comment 5 and response [p. 478] 885–886

Impacts and Costs Analysis, Comment 10 and response [pp. 482 to 484] 886–890

Impacts and Costs Analysis, Comments 6 to 10 and responses [pp. 627 to 630] 890–899

Impacts and Costs Analysis, Comment 11 and response [pp. 630 to 631] 899–902

Impacts and Costs Analysis, Comment 12 and response [pp. 631 to 632] 902–903

Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards
EPA-HQ-OAR-2009-0234-20131
December 2011

Excerpts

Executive Summary, ES.1
[p. ES-1, Table ES-1] 904–907

Executive Summary, ES.1.1, Health Co-Benefits
[pp. ES-3 to ES-4] 908–911

Executive Summary, ES.1.2, Welfare Co-Benefits
[pp. ES-4 to ES-5] 911–912

Executive Summary, ES.2, Tables ES-5, ES-6, Not All Benefits Quantified
[pp. ES-9 to ES-13] 913–923

[pp. 3-10] 924–925

[pp. 3-33] 926–927

[pp. 5-15] 928–929

Chapter 4, Section 4.2 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Human Health) [pp. 4-3 to 4-5] 930–933

Chapter 4, Section 4.3 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Ecosystems and Wildlife) [pp. 4-6 to 4-9] 934–940

Chapter 4, Section 4.8.5.6 (Mercury and Other HAP Benefits Analysis/Unquantified Benefits)
[pp. 4-64 to 4-66] 940–944

Chapter 4, Section 4.9 (Mercury and Other HAP Benefits Analysis/Benefits Associated with Reductions in Other HAP than Mercury)
[pp. 4-68 to 4-73] 944–953

Chapter 5, Synopsis (Health and Welfare Co-Benefits) [p. 5-1] 954–955

Chapter 5, Section 5.5 (Health and Welfare Co-Benefits/Unquantified Health and Welfare Benefits) [p. 5-59] 956

Memorandum, "The Environmental Protection Agency's Enforcement Response Policy for Use of Clean Air Act Section 113(a) Administrative Orders in Relation to Electric Reliability And The Mercury and Air Toxics Standard" (
December 16, 2011 957–970

Memo, "Emission Reduction Costs for Beyond-the-floor Mercury Rate for Existing Units Designed to Burn Low Rank Virgin Coal"
EPA-HQ-OAR-2009-0234-20130
December 16, 2011 971–976

Emission Reduction Costs for the Beyond-the-Floor Mercury Rate in the Toxics Rule
EPA-HQ-OAR-2009-0234-2925
Undated 977–981

The following opinions and order have been omitted in printing this Joint Appendix because they appear on the following pages in the appendix to the Petition for a Writ of Certiorari:

14-46 Michigan, et al. v. EPA, et al.

Federal Register
Volume 70, No. 59
March 29, 2005
Pages 16,000–01 ..... 116a–120a

Federal Register
Volume 76, No. 85
May 3, 2011
Pages 24,987–88 ..... 112a–115a

Federal Register
Volume 77, No. 32
February 16, 2012
Page 9,327 ..... 109a–111a

United States Court of Appeals
for the District of Columbia Circuit
Opinion in 12-1100
issued April 15, 2014 ..... 1a–105a

14-47 UARG v. EPA, et al.

APPENDIX J: U.S. Environmental Protection Agency, EPA-453/R-98-004a, Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units -- Final Report to Congress, Vol. 1 (Feb. 1998), Docket No. EPA-HQ-OAR-2009-0234-3052 (excerpts) 636a

APPENDIX I: U.S. Environmental Protection Agency, Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units; Notice of Regulatory Finding, 65 Fed. Reg. 79,825 (Dec. 20, 2000) 610a

APPENDIX H: U.S. Environmental Protection Agency, Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List; Final Rule, 70 Fed. Reg. 15,994 (Mar. 29, 2005)(excerpt)..... 544a

APPENDIX F: Utility Air Regulatory Group, Comments on National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units: Proposed Rule (Aug. 4, 2011), Docket No. EPA-HQ-OAR-2009-0234-17775 (excerpts)..... 510a

APPENDIX G: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Proposed Rule, 76 Fed. Reg. 24,976 (May 3, 2011) (excerpts) 514a

APPENDIX E: EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units, Vol. 1 (Dec. 2011), Docket No. EPA-HQ-OAR-2009-0234-20126 (excerpts)..... 506a

APPENDIX C: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final Rule, 77 Fed. Reg. 9304 (Feb. 16, 2012) (excerpts) 105a

APPENDIX B: Opinion of the U.S. Court of Appeals for the District of Columbia Circuit.. 3a

APPENDIX A: Order of the U.S. Court of Appeals for the District of Columbia Circuit Denying All Petitions for Review, Except the Petition for Review in No. 12-1174, and Dismissing That Petition 1a

14-49 NMA v. EPA, et al.

APPENDIX F: Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units (excerpts)..... 1937a

APPENDIX E: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, Proposed Rule 76 Fed. Reg. 24,976 (May 3, 2011)..... 1161a

APPENDIX D: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional SteamGenerating Units, 77 Fed. Reg. 9,305 (Feb. 16 2012) 196a

APPENDIX C: 42 U.S.C.S. § 7412.....101a

APPENDIX B: In the United States Court of Appeals for the District of Columbia Circuit – Judgment (Apr. 15, 2014) 99a

APPENDIX A: In the United States Court of Appeals for the District of Columbia Circuit – Opinion (Apr. 15, 2014) 1a

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

RICK SNYDER
GOVERNOR

DAN WYANT
DIRECTOR

August 3, 2011

VIA E-MAIL and U.S. MAIL

Air and Radiation Docket and Information Center
Environmental Protection Agency
Mail Code: 2822T
1200 Pennsylvania Avenue, NW
Washington, DC 20460
a-and-r-Docket@epa.gov

RE: Docket ID No. EPA-HQ-OAR-2009-0234

Dear Sir or Madam:

The Michigan Department of Environmental Quality (DEQ), on behalf of the State of Michigan, submits the attached comments on the U.S. Environmental Protection Agency's proposed rule, "Subpart UUUUU --National Emission Standards for Hazardous Air Pollutants: Coal- and Oilfired Electric Utility Steam Generating Units." The proposed rule was published in the *Federal Register* on May 3, 2011.

Thank you for the opportunity to comment on this proposed rule. If you have any questions regarding these comments, please contact me at 517-373-7069;

hellwigv@michigan.gov; or P.O. Box 30260, Lansing, Michigan 48909.

Sincerely,
G. Vinson Hellwig
G. Vinson Hellwig
Chief Air Quality Division

Attachments

cc/enc:Mr. Jim Sygo, Deputy Director, DEQ
Ms. Mary Ann Dolehanty, DEQ
Mr. Robert Irvine, DEQ
Ms. Teresa Cooper, DEQ
Ms. Julie Brunner, DEQ
Mr. Paul Proudfoot, DLARA
(via email: proudfootp@michigan.gov)

Attachment 1

Michigan Department of Environmental Quality
Comments on U.S. Environmental Protection Agency's Proposed Rule
Subpart UUUUU – National Emission Standards for Hazardous Air Pollutants: Coaland Oil-fired Electric Utility Steam Generating Units
Docket ID No. EPA-HQ-OAR-2009-0234

General

The Michigan DEQ has significant comments and concerns regarding the proposed rule, outlined as follows:

- We recommend just one general subcategory of coal-fired units, not two for mercury.

- For new coal-fired units, the proposed mercury emission limit of 0.000010 pound per gigawatt-hour (lb/GWh) may not be achievable on a reliable basis.

- Sulfur dioxide (SO_2) as an alternate equivalent standard to acid gas hazardous air pollutants (HAPs) is inappropriate based on the three-part legal standard for surrogates.

- We recommend for non-mercury metallic HAPs that the standard take the form of particulate matter less than or equal to 10 microns diameter (PM10) or particulate matter less than or equal to 2.5 microns diameter (PM2.5), not a total particulate matter (PM) standard.

- Calling for a work practice standard with no criteria for what constitutes good combustion is unenforceable and does not serve the purpose of limiting organic HAP emissions. Also, the requirement for a tune-up work practice standard applied to each unit is impracticable as it is written.

- The emissions testing required monthly or every other month depending on the unit and pollutant specified in the proposed rule is excessive and inconsistent.

- The factors and conditions for qualifying and applying for a compliance extension needs to be part of the rule instead of just relying on the language in the Clean Air Act (CAA).

- Replacement power should be allowed to qualify for the compliance extension.

- Michigan has concerns with the Maximum Achievable Control Technology (MACT) floors and beyond-the-floor as they pertain to the emission limit standards for existing and new coal-fired units.

These points are discussed in detail below.

Subcategorization and Mercury

EPA is proposing the following subcategories for mercury emissions only: coal-fired units designed to burn coal with a heat content greater than or equal to 8,300 Btu/lb and a height-to depth ratio of less than 3.82, and coal-fired units designed to burn coal with a heat content less than 8,300 Btu/lb and a

height-to-depth ratio of greater than 3.82. For mercury emissions from coal-fired units, EPA has determined that different emission limits for the two subcategories are warranted because EPA found that emissions of mercury are different between the two situations. For all other HAPs from these two subcategories of coal-fired units, the data did not show any difference in the level of the HAP emissions, and therefore, EPA determined that it was not reasonable to establish separate emissions limits for the other HAPs.

First, the design and height-to-depth ratio of the unit does not impact the control of mercury emissions since mercury control is after the combustion unit. The form of mercury emitted (oxidized, elemental, and particulate-bound forms) when fuel is combusted influences how mercury emissions are controlled. Combustion of higher rank coals such as bituminous coal 1 (generally the greater than 8,300 Btu/lb subcategory) results in more oxidized forms of mercury, whereas, combustion of lower rank coals such as subbituminous coal and lignite coal (generally the less than 8,300 Btu/lb subcategory) results in more elemental mercury. Oxidized and particulate-bound mercury can be captured in existing air pollution control devices such as fabric filter baghouses, electrostatic precipitators (ESPs), and flue gas desulfurization (FGD) systems.

Elemental mercury, however, tends to pass through existing air pollution control devices and requires mercury specific controls. Mercury specific controls include mercury oxidation catalysts and sorbent (e.g. activated carbon) injected into the flue gas prior to

collection in the particulate control device. Halogenated powder activated carbon is particularly effective for the control of mercury that is in the elemental form with control efficiencies reaching 90%. Oxidation catalysts enhance oxidation of elemental mercury to oxidized mercury that can be more readily captured in particulate control devices and FGD systems.

Combustion of bituminous coal and blended bituminous and subbituminous coal with selective catalytic reduction (SCR), particulate control devices such as a dry ESP and fabric filter bag house, and an FGD system in series provides a co-benefit reduction of mercury. This strategy has the potential to control all forms of mercury (elemental, oxidized, and particulate bound) in the combustion gases from solid fuels. Estimated control efficiencies range from 75 to 90 percent depending on the coal blend. The addition of oxidizing chemicals to the fuels and other enhancement additives can also be used to increase mercury capture in existing air pollution control equipment.

In Michigan, many existing units have switched from bituminous coal to subbituminous coal combustion or a blend of both types of coals. With the right combination of emission controls, the proposed mercury emission limit of 1.0 lb/TBtu or 0.0081b/GWh is achievable by existing Michigan units. Due to the Clean Air Interstate Rule (CAIR) and the Cross-State Air Pollution Rule (CSAPR) which replaces CAIR, the addition of fabric filter bag houses (which would support activated carbon injection), SCRs, and wet and/or dry FGD systems is

under way on many Michigan units and can be used to meet the proposed mercury emission limit. However, the proposed mercury emission limit of 0.040 lb/GWh for coal-fired units designed to burn coal with a heat content of less than 8,300 Btu/lb and with a height-to-depth ratio of 3.82 or greater is too high when the 0.008 lb/GWh is achievable by existing units with additional and mercury specific controls. To demonstrate the impact of keeping the 0.040 lb/GWh mercury emission limit, the following example is presented. An 800 megawatt (MW) unit subject to the proposed mercury emission limit of 0.040 lb/GWh would be allowed to emit up to 280 pounds per year of mercury. A similar sized unit operating under the proposed mercury emission limit of 0.008 lb/GWh, would have potential mercury emissions of 56 pounds per year of mercury. Therefore, the subcategory for coal-fired units designed to burn coal with less than 8,300 Btu/lb and with a height-to-depth ratio of 3.82 or greater needs to be eliminated as it creates an unequal bias for low rank coals, is not protective of public health, and technology exists and is in use on existing units which does not justify the subcategorization. We recommend just one general subcategory of coal-fired units.

For existing units, the proposed mercury emission limit of 0.008 lb/GWh, mirrors the requirement in Michigan's mercury rules which were developed through an intense rulemaking process with a stakeholder workgroup consisting of industry, environmental groups, and government agencies such as the Michigan Public Service Commission (MPSC). Michigan's rules outline a mercury

reduction program for coal-fired electric generating units (EGUs) starting January 1, 2015. For existing EGUs, the basic components include three compliance options:

1. A minimum of 90% reduction* from baseline input mercury levels or an output-based mercury emission standard of 0.008 lb/GWh*

2. A multi-pollutant compliance demonstration project which must achieve 75% reduction* from baseline input mercury levels along with significant reductions in nitrogen oxides and sulfur dioxide. (This would be equivalent to a mercury emission limit of 0.020 lb/GWh.)

3. Very Low Mass Emitting (VLME) unit that is limited to 9 pounds of mercury per 12-month rolling time period with an alternative compliance demonstration project.

*12-month rolling average basis.

Michigan's mercury rules also address new EGUs. New EGUs shall not cause or allow the emission of mercury in excess of the maximum allowable emission rate based on the application of best available control technology for mercury. At a minimum, a new EGU shall comply with 90% reduction from input mercury levels on a 12-month rolling average basis or an output-based mercury emission standard of 0.008 lb/GWh on a 12-month rolling average basis.

In the proposed rule, the mercury emission limit of 0.000010 lb/GWh for new coal-fired units may not be

achievable on a reliable basis with the mercury control options available now, and in the foreseeable future based on the information gathered during Michigan's rulemaking process.

Surrogates

Links and relationships need to be established between each surrogate and its respective group of HAPs. Each surrogate emission limit needs to satisfy the legal standard for using a surrogate pollutant for a group of HAPs: (1) the HAPs are invariably present in the surrogate pollutant; (2) the control technology for the surrogate pollutant indiscriminately captures the HAP along with the surrogate pollutant; and (3) the control for the surrogate pollutant is the only means by which facilities achieve reductions in emissions of the HAPs. *(Sierra Club v EPA*, 353 F3d 976, 984 (DC Cir 2004); *National Lime Ass'n v EPA*, 233 F3d 625, 639 (DC Cir 2000))

For acid gas HAPs, EPA is proposing that:

> SO_2 is a suitable surrogate for the acid gas HAP, it could be used as an alternate equivalent standard to the HCl standard for EGUs with FGD systems installed and operated at normal capacity. An SO_2 standard would ensure that equivalent control of the acid gas HAP is achieved, and some facilities may find it preferable to use the existing SO_2 GEMS for compliance purposes rather than having to perform the manual HCl compliance testing. As noted elsewhere, this approach does not work for EGUs that do not have SO_2 controls installed

> and, thus, those EGUs may not utilize the alternate SO_2 limitations.

SO_2 does not meet the criteria for surrogacy because acid gas HAPs are not invariably present in the surrogate pollutant of SO_2 and control of SO_2 is not the only means by which facilities achieve reductions in emissions of acid gas HAPs. For example, hydrogen chloride (HCl) is not present in SO_2 and fuel with lower chlorine concentrations would result in lower HCl emissions when com busted. SO_2 as an alternate equivalent standard to HCl is inappropriate. However, units with SO_2 control systems, that also provide acid gas control, could use an existing SO_2 GEMS as part of a parametric monitoring system. Measuring SO_2 on a continuous basis would demonstrate that the emission control system is operating properly and that compliance with the HCl standard is being achieved under these operating conditions.

EPA is proposing surrogate standards for the non-mercury metallic HAPs. Particulate matter (PM) does meet the criteria to be a surrogate for non-mercury metallic HAPs. What does not appear logical is that the PM surrogate is a total PM (filterable and condensable). As discussed in the preamble to the proposed rule:

> Because non-Hg metallic HAP may preferentially partition to the small size particles (i.e., fine particle enrichment), we considered using PM2.5 as the surrogate, but we determined that total PM (filterable *(i.e.*, PM2.5) plus condensable) was the more appropriate surrogate for two reasons. The

> test method (201A) for measuring PM2.5 is only applicable for use in exhaust stacks without entrained water droplets. Therefore, the test method for measuring PM2.5 is not applicable for units equipped with wet scrubbers which are in use at many EGUs today and may be necessary at some additional units to achieve the proposed HCl emission limitations. Thus, we are proposing to use total PM, instead of PM2.5, as the surrogate for non-Hg metals.

Since metals preferentially partition and are of concern in the fine fraction, selecting a surrogate that does not reflect the concentration of the fine fraction nor have a health-based standard does not appear appropriate. Total PM does not protect public health because it does not limit emissions of fine PM. PM10 or PM2.5 appears to be the better surrogate because they would appropriately limit the fine fraction, and therefore, non-mercury metallic HAPs. Non-mercury metallic HAPs do exist in the filterable portion of PM not just the fine PM fraction. Filterable PM emissions are more dependent on the control device being designed and operated properly where as condensable PM is more influenced by the inorganic properties of the exhaust gases and can pass through commonly used particulate control devices such as a dry ESP and fabric filter baghouse. Filterable PM as a surrogate for total PM as listed in the proposed rule does not work because emissions of the condensable PM portion are influenced by fuel characteristics as opposed to proper operation of a control device.

As a final issue, the usefulness of the proposed alternative individual non-mercury metallic HAPs emission limits is questionable. As stated in the preamble to the proposed rule:

> PM was also chosen instead of specific metallic HAP because all fuels do not emit the same type and amount of metallic HAP but most generally emit PM that includes some amount and combination of all the metallic HAP. The use of PM as a surrogate will also eliminate the cost of performance testing to comply with numerous standards for individual non-Hg metals.

The type and amount of metallic HAPs in fuels such as coal and oil can be highly variable, and therefore, not extremely predictable. For this reason, alternative individual non-mercury metallic HAPs emission limits may not be used by sources subject to this regulation and this alternative should be removed. We recommend that the standard only take the form of PM10 or PM2.5 to appropriately limit emissions of non-mercury metallic HAPs.

Work Practice Standard

As stated in the preamble to the proposed rule:

> EPA is proposing work practice standards for non-dioxin/furan organic and dioxin/furan organic HAP. The significant majority of measured emissions from EGUs of these HAPs were below the detection levels of the EPA test methods, and, as such, EPA considers it impracticable to reliably measure emissions from these units.

And,

> Tests were also conducted to examine potential surrogacy relationships for the non-dioxin/furan organic HAP. The amounts of Hg, non-Hg metals, HCl, HF, and Ch in the flue gas are directly related to the amounts of Hg, non-Hg metals, chlorine, and fluorine in the coal. Control of these components generally requires downstream control technology. However, the presence of the organics in the flue gas is not related to the composition of the fuel but rather they are a result of incomplete or poor combustion. Control of the organics is often achieved by improving combustion conditions to minimize formation or to maximize destruction of the organics in the combustion environment.

Work practice standards are appropriate if measurement of a pollutant is technically or economically problematic, however, organic HAPs can be measured from a technical and economic perspective. Therefore, a work practice standard is inappropriate for this 112(d) standard. A more appropriate approach would be to use a surrogate to demonstrate reductions in organic HAPs.

Good combustion practices that promote complete combustion of fuel in the boiler is an effective pollution control measure for organic HAPs. And, existing units do not use means other than good combustion practices to control organic HAPs. Good combustion control can be demonstrated by continuous monitoring of CO emissions. Continuous monitoring of CO emissions is used to, among other

things, optimize the air to fuel ratio to ensure the maximum combustion of fuel, which in turn ensures minimum emissions of organic HAPs. Therefore, continuous monitoring of CO which demonstrates good combustion practices and insures minimization of organic HAP emissions at all times would be acceptable as part of a parametric monitoring system.

Calling for a work practice standard with no criteria for what constitutes good combustion is unenforceable and does not serve the purpose of limiting organic HAP emissions. A tune-up is not a criterion, particularly if the tune-up is on a unit that has switched fuels. The unit will not be as efficient, and therefore, organic HAP emissions will be higher with fuels that it was not originally designed to combust. A tune-up will only go so far in reducing organic HAP emissions from units that have switched fuels.

Also, the work practice standard appears to be missing from the proposed rule as Table 3 to Subpart UUUUU of Part 63 (p. 25129) titled "Work Practice Standards" instead contains references to performance tests. This table needs to be removed from the rule as it does not contain any work practice standards.

Finally, the requirement for a tune-up work practice standard applied to each unit is impracticable as it is written. While the intent for this requirement is understandable as it mandates sources to conduct regular maintenance to ensure that the unit is operating at optimal efficiency, it poses many problems as currently proposed. The requirement to

conduct a performance tune-up no more than 18 months after the previous performance tune-up would not be a problem for a source that has only one or two subject units. However, for those sources that have three or more subject units, this requirement becomes burdensome to the point where they are constantly taking units off-line to do burner inspections. Many of these multiple unit sources already have regularly scheduled maintenance for these units where they bring down the unit for tune-ups and/or manufacturer's recommended maintenance. The requirement should be that any time the unit is shutdown or no more than 36 to 48 months since the previous burner inspection, the burner must be inspected. Also, for those units that do not have manufacturer's specifications, who makes the determination for what is the optimal flame pattern and the optimal total emissions of CO and NO_x for those units? These conditions are unenforceable as written. It would be more practicable to require training and operator certification, identify who is required to be trained and certificated, identify what the training will encompass, and the frequency of training. Operational manuals should also be required that cover the procedures for boiler operation including, but not limited to, startup, shutdown, and malfunction; load changes; the optimal operating conditions of the boiler; and recordkeeping and reporting requirements.

Compliance Monitoring

As stated in the preamble:

> We are proposing testing, monitoring, notification, and recordkeeping requirements that are adequate to assure continuous compliance with the requirements of this proposed rule.

As an example of the testing and monitoring requirements:

> However, units equipped with devices that control PM and HCl emissions, but do not elect to use GEMS, would determine suitable parameter operating limits, to monitor those parameters on a continuous basis, and to conduct emissions testing every other month.

The emissions testing required monthly or every other month depending on the unit and pollutant specified in the proposed rule is excessive and inconsistent. If an acceptable parametric monitoring system is developed, emissions testing once a year or every other year should be sufficient. Even if no emission control system is in place, unless a significant change in the fuel characteristics occurs, emissions testing once a year or every other year should also be sufficient. At a minimum, make the testing and monitoring requirements consistent for the units and pollutants.

The proposed rule includes a low emitting EGU (LEE) definition for compliance monitoring purposes. For mercury, emissions less than 10 percent of the mercury emissions limitation or less than 22.0 pounds per year on an existing unit may qualify for LEE status for mercury. For Michigan's mercury rules, a cut-off of 9 pounds per year, per unit was

developed as protective through the rulemaking process. This could be a smaller utility unit (25 MW to 100 MW) or a larger unit with low utilization where installing a mercury GEMS is not feasible due to low emissions or economical due the unit utilization.

Compliance Extension

As stated in the preamble:

> Existing sources may be provided up to 3 years to comply with the final rule; if an existing source is unable to comply within 3 years, a permitting authority has the discretion to grant such a source up to a 1-year extension, on a case-by-case basis, if such additional time is necessary for the installation of controls.

But, the actual proposed rule does not clarify the 1-year extension option. The extension, with the factors and conditions for qualifying and applying for the extension, needs to be part of the rule. Michigan's mercury rules have conditions for applying for technical and economic extensions, and the proposed rule should include similar requirements for the compliance extension. As an example:

1. The representative of an existing EGU shall submit an administratively complete extension request before the applicable compliance year (i.e., before the rule goes into effect).

2. An administratively complete request shall include, at a minimum, information on the emission

control technologies to be installed to comply with the rule, emissions estimates, and a proposed compliance program for the rule.

3. In addition, the representative may submit, any other relevant information supporting approval of an extension which could include replacement power, reliability issues, construction timing, etc.

4. The permitting authority shall review and approve an extension request and compliance schedule based on the information submitted.

As stated in the preamble:

> Because the phrase "installation of controls" could also be interpreted to apply only to changes made to an existing unit rather than the replacement of that existing unit with a new cleaner one, EPA takes comment on its proposal to allow the extension to apply to replacement power.

Replacement power should be allowed to qualify for the extension because it takes time to plan, finance, and construct new generating capacity to replace existing capacity.

MACT Floors and Beyond-the-Floor

Michigan has concerns with the MACT floors and beyond-the-floor as they pertain to the emission limit standards for existing and new coal-fired units. Michigan has completed three 112(g) case-by-case maximum achievable control technology determinations for solid fuel-fired EGUs, and one major new source review (NSR) determination on an

existing coal-fired power plant with four solid fuel-fired EGUs. The general approach taken for the 112(g) determination was to obtain information on units permitted since 1999 using the assumption that newer units would be the best performing. In Attachment 2 is a summary of this information, which includes data from permits, permit reviews, and compliance testing for comparison to the MACT emission limit standards assessed for the proposed rule.

For an example of an existing unit, a modified coal-fired power plant that has gone through NSR and state-only best available control technology for toxics (T -BACT) was compared to the proposed rule. This power plant has two units rated at 817 MW (gross output) and two units rated at 823 MW (gross output). All four units are pulverized coal-fired boilers of 1970's vintage with a nominal design gross heat input rating of 7,624 MMBtu/hr per boiler and equipped with low- NO_x burners, overfire air, SCRs, ESPs, and wet FGD systems. The T-BACT, and for SO_2 the BACT, emission limits were also converted to output-based standards for comparison using the design input and output ratings of the units. The numbers are summarized in the table below. These units were originally designed to combust bituminous coal. But, have been permitted to combust a blend of bituminous coal and subbituminous coal and up to 10% petroleum coke

Pollutant	T-BACT Emission Limit - Permit limit	T-BACT Emission Limit - Calculated Output	Subpart UUUUU Emission Limit – Existing Unit
Total PM (surrogate for non-mercury metallic HAPs)	--	--	0.030 lb/MMBtu or 0.30 lb/MWh
Filterable PM (surrogate for non-mercury metallic HAPs and toxics)	0.011 lb/MMBtu	0.10 lb/MWh	--
VOC (surrogate for organic HAPs and toxics)	0.0034 lb/MMBtu	0.032 lb/MWh	Work practice standard
SO_2 (BACT)	0.107 lb/MMBtu	1.0 lb/MWh	SO_2 surrogate of 0.20 lb/MMBtu or 2.0 lb/MWh
HCl (surrogate for acid gas HAPs and toxics)	0.0024 lb/MMBtu	0.022 lb/MWh	0.0020 lb/MMBtu or 0.020 lb/MWh
HF (surrogate for acid gas HAPs and toxics)	0.00023 lb/MMBtu	0.0021 lb/MWh	--
Mercury	2.1 lb/TBtu (calculated)	0.02 lb/GWh (permit limit)	1.0 lb/TBtu or 0.008 lb/GWh (if >8300 Btu/lb) and, 4.0 lb/TBtu or 0.040 lb/GWh (if <8300 Btu/lb)
Arsenic (As)	6.3×10^{-6} lb/MMBtu	0.059 lb/GWh	2.0 lb/TBtu or 0.020 lb/GWh

Note: These units do have a PM10 emission limit of 0.024 lb/MMBtu that when converted to an output-based emission limit would be 0.22 lb/MWh.

These existing units as permitted could have problems meeting the proposed standards in Subpart UUUUU for HCl and mercury. For mercury, since the units do fuel switch and are designed for a higher heat input coal, mercury specific control could be added to meet the standard.

For an example of a new unit, the 112(g) MACT emission limits assessed by Michigan DEQ for a new 930 MW (gross rated output) advanced supercritical pulverized coal-fired boiler with a nominal design gross heat input rating of 8,190 MMBtu/hr, equipped with low- NO_x burners, overfire air, SCR, hydrated lime injection, sorbent (e.g., powdered activated carbon), fabric filter bag house, and wet FGD system were converted to an output-based standard using the design input and output ratings of the unit. The numbers are summarized in the table below. This unit is designed to combust 100% subbituminous coal with up to 50% bituminous coal.

Pollutant	112(g) MACT Emission Limit - Permit limit	112(g) MACT Emission Limit - Calculated Output	Subpart UUUUU Emission Limit – New Unit
Total PM (surrogate for non-mercury metallic HAPs)	--	--	0.050 lb/MWh
Filterable PM (surrogate for non-mercury metallic HAPs)	0.011 lb/MMBtu	0.097 lb/MWh	–
VOC (surrogate for organic HAPs)	0.0030 lb/MMBtu	0.026 lb/MWh	Work practice standard
SO_2 (BACT)	0.06 lb/MMBtu	0.53 lb/MWh	SO_2 surrogate of 0.40 lb/MWh
HCl (surrogate for acid gas HAPs)	0.0010 lb/MMBtu	8.81 lb/GWh	0.30 lb/GWh
HF (surrogate for acid gas HAPs)	0.00014 lb/MMBtu	1.23 lb/GWh	–
Mercury	--	0.0079 lb/GWh (permit limit)	0.000010 lb/GWh (if >8300 Btu/lb) and, 0.040 lb/GWh (if <8300 Btu/lb)

Note: This unit does have a PM10 emission limit of 0.024 lb/MMBtu that when converted to an output-based emission limit would be 0.21 lb/MWh.

This new unit as designed and permitted will not be able to meet the proposed standards in Subpart UUUUU with the possible exception of mercury since the unit will likely be designed for a lower heat input coal, and organic HAPs, since no standard is proposed.

The standards for new units appear unachievable with the control options available now, and in the foreseeable future. And, conversely the standards for existing units appear too generous for those pollutants whose emissions can be accurately predicted if the unit is well controlled.

NACAA
national association of clean air agencies

444 North Capitol Street, NW * Suite 307 * Washington, DC 20001 * phone 202.624.7864 * fax 202.624.7863 * www.4cleanair.org

Board of Directors (***)

August 4, 2011

EPA Docket Center
EPA West (Air Docket)
Attention Docket Nos. EPA-HQ-OAR-2009-0234; EPA-HQ-OAR-2011-0044
U.S. Environmental Protection Agency
Mail Code 2822T
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Dear Sir/Madam:

On behalf of the National Association of Clean Air Agencies (NACAA), thank you for this opportunity to comment on the proposed National Emission Standards for Hazardous Air Pollutants[1] and Revisions to the New Source Performance Standards for Fossil Fuel-fired Electric Generating

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[1] The proposed emission limits, commonly referred to as maximum achievable control technology or "MACT standards," will substantially reduce emissions of hazardous air pollutants ("HAPs") from coal- and oil-fired electric generating units ("EGUs").

Units[2], which were published in the *Federal Register* on May 3, 2011 (76 *FR* 24976). NACAA is the national association of air pollution control agencies in 51 states and territories and over 165 metropolitan areas across the country. Attached to this letter is a document containing NACAA's detailed comments on the proposals.

NACAA strongly supports adoption of effective limitations on mercury, toxic acid gas, toxic metal emissions and other pollutants from these large sources. NACAA agrees with EPA's original determination in 2000 that regulating HAPs emissions from EGUs under Clean Air Act section 112 is "appropriate and necessary." We believe that EPA's reversal of that finding in 2005 was incorrect and support EPA's confirmation of the initial determination. We can think of no reason why Congress would seek to limit emissions of HAPs from dry cleaners, electroplaters and other small businesses and, at the same time, exempt the largest sources of HAPs emissions in the country.

Seventeen years have now passed since the 1994 deadline for completion of EPA's utility study and the courts have ruled on every conceivable related issue.

The determination of whether mercury emissions from this sector should be regulated has been the subject of two in-depth reviews by EPA, as well as

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[2] The NSPS proposal would, if adopted, provide more stringent limits for emissions of sulfur dioxide ("SO_2"), nitrogen oxides ("NO_x") and particulate matter ("PM") for new units in these source categories.

one by the National Academy of Sciences. It is now well past time for EPA to complete these rules and, for the first time, limit emissions of HAPs from this very significant source category, as originally contemplated by Congress over 40 years ago. Updating the NSPS for this source category will ensure that, as the existing, aging fleet of fossil-fuel-fired units retires, the units that replace them will be as clean as today's technology reasonably permits.

The final regulations should meet both the letter and the intent of the statute, and strike the appropriate balance between protecting public health and avoiding the imposition of unnecessary costs on the regulated community. EPA has projected quite substantial reductions in emissions of mercury and hydrogen chloride ("HCl"), as well as substantial reductions in fine particulate matter and SO_2 from the proposed requirements. These reductions are needed to protect public health and to improve the environment. The data obtained from the most recent round of industry testing support emissions standards at least as stringent as those proposed by EPA. The technology needed to meet these standards has been in use in this sector for 10 to 40 years, and has been shown to be effective and affordable.

NACAA believes that the proposed emission limitations are, for the most part, protective of public health and supports EPA's rejection of alternate compliance limits under section 112(d)(4) of the Clean Air Act, where there is insufficient scientific information to establish a "safe" threshold for the HAPs at issue. However, while the proposed limits are generally supportable from a policy perspective,

the CAA requires a very high degree of protection from HAPs emissions and does not provide EPA the broad discretion in setting MACT floors that it enjoys when promulgating MACT ("beyond the floor") standards and regulating criteria pollutants. As set out in detail in the attached comments, a number of the assumptions and procedures employed in the calculation of certain MACT floors are unsupported or improper and should be revisited.

NACAA believes the subcategories established by EPA are reasonable. We caution against creating additional small subcategories, where insufficient data undermine the calculation of MACT floors. NACAA also recommends that EPA establish standards based on the application of MACT technology, rather than merely calculating MACT floors, and suggests that MACT be no less stringent than BACT. NACAA suggests EPA address organic HAP emissions, including dioxins, furans and products of incomplete combustion, and calculate MACT floors and evaluate MACT technologies for these pollutants in the EGU sector, just as it has done for other sectors. Work practice standards, if employed, should be designed to achieve the same level of emission performance as would be achieved by implementation of an emission limitation.

Finally, these important new requirements will add to the existing workload of state and local air pollution control agencies at a time when additional state and local funding is unlikely to be available. We strongly urge that federal grant funding, sufficient to support these activities, be provided so this important work can be undertaken.

Thank you for this opportunity to comment on the proposal. Please contact us if we can provide additional information.

Sincerely,
S. William Becker
S. William Becker

COMMENTS OF THE NATIONAL ASSOCIATION OF CLEAN AIR AGENCIES CONCERNING EPA'S PROPOSED NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS AND PROPOSED REVISIONS TO THE NEW SOURCE PERFORMANCE STANDARDS FOR FOSSIL FUEL- FIRED ELECTRIC GENERATING UNITS

Docket Nos. EPA-HQ-OAR-2009-0234;
EPA-HQ-OAR-2011-0044

August 4, 2011

The National Association of Clean Air Agencies ("NACAA"), an association of state and local air pollution control agencies in 51 states and territories and over 165 metropolitan areas across the country, is pleased to submit the following comments concerning the U.S. Environmental Protection Agency's ("EPA") proposal to adopt National Emission Standards for Hazardous Air Pollutants ("NESHAPs") under section 112(d) of the Clean Air Act ("CAA"). The proposed emission limits, commonly referred to as maximum achievable control technology or "MACT standards," will substantially reduce emissions of hazardous air pollutants ("HAPs") from coal- and oil-fired electric generating units ("EGUs").

In addition, EPA has proposed revisions to the New Source Performance Standards ("NSPS") for fossil fuel-fired EGUs and Industrial, Commercial and Institutional Boilers ("ICI Boilers"). These

revisions will ensure that, as the existing, aging fleet of fossil-fuel-fired units retires, the units that replace them will be as clean as today's technology reasonably permits. The NSPS proposal would, if adopted, provide more stringent limits for emissions of sulfur dioxide ("SO_2"), nitrogen oxides ("NO_x") and particulate matter ("PM") for new units in these source categories. These combustion units are among the largest emitters of toxic and criteria pollutants in the country. Accordingly, the benefits to public health and the environment that will result from well-considered rules are substantial.

NACAA strongly supports adoption of effective limitations on mercury, toxic acid gas and toxic metal emissions from these large sources. The final regulations should meet both the letter and the intent of the statute and strike the appropriate balance in protecting public health, while avoiding the imposition of unnecessary costs on the regulated community. EPA has conducted analyses employing the Integrated Planning Model ("IPM")[1] that project quite substantial reductions in emissions of mercury and hydrogen chloride ("HCl"), as well as substantial reductions in $PM_{2.5}$[2] and SO_2. These reductions are needed to protect public health and to improve the environment. NACAA believes that the data obtained from the most recent round of industry testing support emissions standards at least as stringent as those proposed by EPA. The technology

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[1] The IPM is used to evaluate least cost solutions to potential changes in EPA regulations.

[2] Fine particulate matter less than or equal to 2.5 microns in diameter.

needed to meet these standards has been in use in this sector for 10 to 40 years, and has been shown to be effective and affordable. Seventeen years have now passed since the 1994 deadline for completion of EPA's study of whether MACT standards were needed with the Acid Rain program in place and the Courts have ruled on every conceivable issue. The determination of whether mercury emissions from this sector should be regulated has been the subject of two in-depth EPA reviews, as well as a review by the National Academy of Sciences. It is now well past time for EPA to complete these rules and, for the first time, limit emissions of HAPs from these very significant source categories, as originally contemplated by Congress over 40 years ago.

NACAA believes that the proposed emission limitations are within the range of those authorized under the Act and are protective of public health. However, NACAA's review of the record does indicate several instances where limits could and should be more stringent and a number of instances where EPA needs to do a better job of explaining and supporting its proposed decisions.

"NECESSARY AND APPROPRIATE"

EPA's attempted reversal, in 2005, of its earlier "necessary and appropriate" finding assumed that regulation under section 112 would not be "necessary" if any other statutory authority could be found to reduce mercury emissions. This interpretation is not supported in the context of the overall statute and was properly rejected by the U.S. Court of Appeals. Congress clearly believed that regulation of HAPs under section 112 was necessary

and appropriate for many sectors of the economy – from dry cleaners to cement kilns. The purpose of the utility studies required by Congress, and the question to be answered by EPA, was whether the SO_2 and NO_x emission limitations under the Acid Rain program reduced HAPs emissions from the EGU sector to the point where further reductions would be inconsistent with the risks posed by the other sectors for which standards had been or would be implemented.

Importantly, the Court concluded that, having determined in 2000 that regulation of EGUs was necessary and appropriate, the only procedure available to EPA to reverse that decision is delisting under section 112(c)(9)(B) of the CAA. That section requires a demonstration that no source in the category emits carcinogens at a level that would increase the cancer risk to the most exposed population by more than one in one million, that no source in the category emits at a level that exceeds that needed to protect public health[3] with an adequate margin of safety *and that there will be no adverse environmental impact from the source's emissions*. No such showing has been made or attempted.

EGUs generate approximately half of the man-made U.S. emissions of mercury and from 19 to 83 percent of U.S. emissions of antimony, arsenic, beryllium, cadmium, chromium, cobalt, manganese, nickel and selenium. EGUs also emit a large number

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[3] For many of the HAPs emitted by fossil fuel-fired EGUs, no "safe" level of exposure has been established.

of different organic HAPs; most of the mass of these emissions is in the form of formaldehyde, benzene and acetaldehyde[4]

It cannot be said that the incidence of cancer, impaired child development and other ailments caused by exposure to these pollutants has decreased to the point that the public health problem identified by Congress in 1990 has been fully addressed.[5] Indeed, the most recent EPA assessment[6] of cancer risks from ambient HAPs concentrations estimates that the entire U.S. population at the time of the assessment had an increased cancer risk of greater than 10 in one million,[7] while 13.8 million people have an increased cancer risk of greater than 100 in a million, as a result of breathing HAPs at 2005 ambient levels over the course of their lifetime. Key HAPs contributing to cancer and non-cancer risks include formaldehyde, benzene, arsenic, chromium, nickel and hydrochloric acid, each of which is emitted in significant quantities by EGUs, even after full implementation of the Acid Rain program.

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[4] See, 76 FR 24978, 25006, 25006 (May 3, 2011) citing to Strum, M., Thurman, J., and Morris, M., U.S. Environmental Protection Agency. Non-Hg Case Study Chronic Inhalation Risk Assessment for the Utility MACT "Appropriate and Necessary" Analysis. Memorandum to Docket EPA-HQ-OAR-2009-0234. March 1, 2011, the mercury study and the 2005 NATA Inventory.

[5] Similarly, the adverse impacts on the environment associated with these pollutants cannot be said to have been sufficiently reduced by other CAA programs.

[6] *2005 National Air Toxics Assessment*, USEPA, March, 2011.

[7] An excess cancer risk of one in one million is commonly considered a reasonable regulatory threshold.

Some have argued that reducing ambient air concentrations of HAPs does not provide meaningful health benefits since most of our daily exposure is to indoor air.[8] Indoor sources of certain HAPs, which are not regulated under the CAA, may indeed in some instances be a major contribution to the exposure of the public to those HAPs.

However, it has also been shown that the HAPs in the ambient air are responsible for a substantial portion of the HAPs found in indoor air. HAPS in the ambient air have been found to be responsible for approximately 20 percent of the indoor levels of formaldehyde and acetaldehyde, and about two-thirds of the benzene found indoors[9]. Strong associations were also found between indoor air and outdoor air concentrations of $PM_{2.5}$ and the associated metal HAPs, such as arsenic and selenium.[10] Congress listed selenium compounds among the HAPs that must be controlled by EPA under section 112. It did so recognizing that exposure to selenium and/or certain of its compounds can result in adverse respiratory effects and that these compounds are possible or probable human carcinogens. The EGUs that are the subject of the

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[8] This does not suggest that overall cancer risks from HAPs are lower since indoor levels of certain carcinogenic HAPs, such as formaldehyde, are generally higher than ambient levels.

[9] Patrick L. Kinney, Steven N. Chillrud, Sonja Sax, James M. Ross, David Macintosh, Ted A. Myatt, and John D. Spengler, Toxic Exposure Assessment: A Columbia-Harvard (TEACH) Study (The Los Angeles Report); (2009).

[10] Teach Study, supra.

proposed regulations are responsible for 83 percent of the selenium emitted to the ambient air.[11]

In its Mercury Study Report to Congress (1997) EPA estimated that 7 percent of women of childbearing age would have blood mercury concentrations greater than that equivalent to the reference dose[12] This estimate is based on patterns of fish and shellfish consumption and methyl mercury concentrations present in fish and shellfish. Blood mercury analyses in the 1999-2000 National Health and Nutrition Examination Survey (1999-2000 NHANES) for 16- to 49-year-old women showed that approximately 8 percent of women in the survey had blood mercury concentrations greater than the blood mercury level equivalent to the reference dose. Based on these data, EPA has estimated that more than 300,000 infants born each year may have increased risk of learning disabilities associated with in utero exposure to methyl mercury.

NACAA anticipates that some opposed to the proposed regulation of mercury will cite to the existence of a global atmospheric pool of mercury and relatively low projected reductions in average mercury deposition rates associated with the proposed rule in support of their position.

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[11] 76 FR 24978, supra, at 24978.

[12] A reference dose is an EPA estimate, with uncertainty spanning perhaps an order of magnitude, of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.

According to this argument, U.S. EGU emission reductions should have negligible benefits for local and regional environments because the reductions from these sources will be insignificant compared to mercury deposition from the global mercury pool.[13] While a global mercury pool does exist, data collected at a number of U.S. locations over the past decade show that reductions in point source air emissions of mercury produce substantial improvement in the local and regional environment shortly after those reductions are implemented. Indeed, ongoing monitoring efforts in a number of states indicate that mercury levels in fish and other biota have fallen as those states have begun to address sources of mercury pollution.

In November, 2002, an enhanced air monitoring site was established in Steubenville, Ohio to investigate source-receptor relationships for mercury deposition in Eastern Ohio. The site overlooking the Ohio River was in close proximity to several anthropogenic point sources, including EGUs. The data collected during this study demonstrated that approximately 70 percent of the mercury in wet deposition was due to coal combustion and that a significant portion of the mercury deposited in the immediate vicinity of local EGUs was directly attributed to those local sources. The University of Michigan researchers concluded that "it has become evident that near-field impact of coal fired utility boilers on Hg deposition is significant and

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[13] It should be mentioned that U.S. emissions contribute to the global mercury pool.

underestimated by the models that have been utilized in previous policy decision making."[14]

Similarly, wet deposition data collected throughout the Great Lakes over the past decade have demonstrated distinct regional variability that undercuts any suggestion that local mercury emission efforts are of no value. Precipitation samples collected in southeastern Michigan showed a 25- to 35-percent increase in the Hg concentration between urban sites in Detroit and a rural site 40 miles to the east. This phenomenon is not limited to the northern part of the country. Studies in south Florida revealed that the spatial and temporal patterns of wet deposited mercury were also strongly influenced by local sources. National data show similar variability in deposition rates; mercury deposition rates attributable to U.S. EGU emissions at the most affected water bodies are eight times the mean rate of such deposition. EPA's modeling suggests that the proposed rule will reduce this local excess deposition from U.S. EGUs by 80 percent. NACAA believes that such a result would be a significant benefit to public health and the environment.

EPA has also modeled the reduction in adverse health impacts associated with the proposed reductions in mercury emissions. However, EPA's model is limited in that it includes only self-caught freshwater fish as a food consumption exposure

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[14] Gerald J. Keeler, Matthew S. Landis, Gary A. Norris, Emily M. Christianson, and J. Timothy Dvonch, *Sources of Mercury Wet Deposition in Eastern Ohio, USA*, pub *Environ. Sci. Technol.*, 2006, *40* (19), pp 5874–5881.

pathway and excludes the impacts associated with mercury found in commercially caught fish or saltwater fish. While there are some communities where self-caught freshwater fish form a significant part of the diet, for most of the U.S. population, commercially caught freshwater fish and saltwater fish constitute the vast majority of the fish consumption and their consumption is the dominant mercury exposure pathway. Thus, EPA's modeling is of limited usefulness in assessing the health impacts of the proposed rules.

Given the global dispersion of elemental mercury, excess exposure to mercury will not be reduced to acceptable levels by the proposed MACT standards, or for that matter, by any action that the U.S. could take by itself. Global anthropogenic emissions are in the range of 2,100 to 2,500 tons per year ("tpy"), with global fossil-fueled emissions estimated at 500 to 900 tpy. The U.S. contribution to this amount is less than five percent. However, the U.S. is currently engaged in international efforts to reduce global mercury emissions. The third session of the United Nations Environment Programme ("UNEP") Intergovernmental Negotiating Committee will be held in November 2011 to attempt to prepare a global legally binding instrument for the control of mercury. The UNEP negotiation schedule calls for an agreement to be reached by February 2013. The U.S. position paper on these negotiations, submitted to the UNEP in March of this year, correctly calls for **mandatory** limits on mercury emissions, based on application of Best Available Techniques ("BAT") at all significant source categories, rather than merely

encouraging the use of such techniques,[15] as some in the international community advocate. NACAA believes that mandatory mercury emission reductions from the international community are essential if the mercury problem in this country is to be effectively addressed and submits that, if the U.S. fails to require BAT levels of controls of its EGU sector, the prospects for an international agreement will be substantially diminished. For this reason, effective mercury regulation of U.S. EGUs, while not sufficient in and of itself, is nonetheless a necessary component of the larger program that is needed to effectively address excess mercury exposure of sensitive U.S. populations, including U.S. children and pregnant women.

Even though precise quantification of the harm is difficult, the general public and those involved in protecting public health remain concerned about mercury hot spots and fish consumption advisories, and about areas of high cancer incidence that are associated with high local concentrations of carcinogenic HAPs.

While there are a lack of specific epidemiological data concerning HAPs impacts on a national scale, greater information is available concerning the economic and public health benefits of reducing fine particulate matter. This information demonstrates

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[15] The United States' submission calls for the use of best available techniques for such sources as soon as practicable, but no later than [a date to be negotiated] years after the entry into force of the Convention. See, http://www.unep.org/hazardoussubstances/Portals/9/Mercury/Documents/INC3/United%20States.pdf.

that the proposed rules will provide a very significant positive public health and economic benefit, beyond what is associated with reductions in the HAPs themselves. EPA's estimate is that the annual cobenefits from reducing $PM_{2.5}$ will be 6,800 – 17,000 fewer premature deaths, 11,000 fewer nonfatal heart attacks, 12,200 hospital visits avoided and 120,000 fewer cases of aggravated asthma. The economic benefit associated with the reduction in fatalities and health care costs, and the resulting improved productivity, is estimated at between $59 billion and $140 billion per year, as against a cost of $10.9 billion per year. Thus, the rate of return to the public for its investment in improved pollution controls is $6 to $14 for each dollar spent. In addition, some of the most toxic HAP emissions being controlled by this rule are associated with fine particulates. These include toxic heavy metals and toxic particulate organic matter. Therefore, it is critical that EPA proceed to adopt its proposed MACT limits on total fine particle emissions from coal and heavyoil combustion to address the many particulate HAPs emitted by these sources. EPA's proposed limits for total particulates will appropriately require upgrades for particulate control systems on poorly controlled power plants. Good particulate control is a basic necessity for control of particulate HAPs. It also enables more effective control of acid gas HAPs and gaseous mercury where reagent injection is used.

The reductions in SO_2 and $PM_{2.5}$ required by the proposed rules will also provide substantial assistance to state and local air pollution control agencies as they develop and implement programs to

meet health-based air quality standards, as well as regulations intended to reduce haze and improve visibility. Because of the substantial reductions in emissions that will be made at these very large sources under the proposed rules, there will be less of a need for state and local authorities to require pollution controls at smaller sources in order to meet health-based ambient air requirements. Since pollution controls at large EGUs are far more cost effective than controls at smaller facilities, controlling EGU emissions is the lowest cost path to improved public health and a cleaner environment.

FEASIBILITY

The emission reductions anticipated by the proposal will, in part, be the result of operators switching to cleaner forms of coal and oil, including, for example, by coal washing prior to combustion. Reductions will also be generated by the application of one or more of the following technologies: fabric filters ("FF," otherwise known as bag houses) for control of many toxic metal emissions: acid gas scrubbers for control of HCl, hydrogen fluoride and hydrogen cyanide; and sorbent injection, including activated carbon injection (ACI), to assist in controlling mercury and organic HAPs. For those units with SO_2 scrubbers, an option is provided to meet SO_2 emission limits rather than new limits on HCl emissions. Simple work-practice standards, such as combustion system tune ups and regular maintenance of existing equipment, are used to minimize emissions of other toxic air pollutants emitted by these units. While there are always new technologies being developed, and existing

technologies are constantly being improved, the proposed emission levels do not rely on such improvements. Rather, these new standards can be met by application of existing technologies. Years, and in some cases decades, of experience demonstrates that these technologies can reliably deliver the expected performance at reasonable cost.[16]

EPA IPM modeling estimates that the proposed limits will result in 83 gigawatt[17] ("GW") of new scrubbing[18] and 65 GW of dry sorbent injection ("DSI") added to the existing 145 GW of capacity that already has scrubbing. It also anticipates adding 98 GW of ACI capacity to the existing 48 GW of ACI-controlled generation capacity. Generating capacity using Selective Catalytic Reduction ("SCR") for NO_x control is projected to increase from 120 GW to 146 GW.[19] Given the age of U.S. coal-fired plants, it is also reasonable to assume that some operators will

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[16] See, e.g., National Energy Technology Laboratory, U.S. Department of Energy, *Cost and Performance Baseline for Fossil Energy Plants; Volume 1. Bituminous Coal and Natural Gas to Electricity*, Rev. 2, November , 2010, ES- 5, ES-7 http://www.netl.doe.gov/energy-analyses/pubs/BitBase_FinRep_Rev2.pdf.

[17] A gigawatt is one billion watts or 1,000 megawatts ("MW"). The U.S. has approximately 300 GW of coal-fired electric generating capacity. [http://www.eia.gov/cneaf/electricity/page/capacity/existingunitsbs2008.xls says in 2008 US had 337 GW coal, 64 GW oil, 455 GW gas, totaling 856 GW fossil].

[18] Wet or dry flue gas desulfurization or "FGD."

[19] No increase in the use of selective non-catalytic control technology is projected.

elect to replace existing coal-fired units with lower cost natural gas-fired generation.

Recent history in reducing emissions (such as the Clean Air Interstate Rule discussed below) demonstrates that these controls can be added in the time frame required by the CAA without disrupting supplies of electricity. ACI and DSI require relatively little capital construction and normally involve installation schedules of less than 12 and 24 months respectively.[20] FGD and SCR control technologies require longer schedules, but industry has already demonstrated its ability to add the projected amount of new controls within the statutory deadline (three years, plus one additional year if needed). The most significant emission reduction programs affecting EGUs in the past 15 years were the NO_x SIP call and the CAIR rule.[21] Source-specific obligations under those programs would not be known until the development and approval of state plans under the federal rule. In each of those programs EPA approval of implementing SIPs occurred less than three years from the applicable compliance date and in each instance compliance was achieved. In 2003, alone, 26 GW of new SCR controls – the amount projected for the current proposal came on line to meet the NO_x SIP call. In the 2000-2004 time frame approximately 70 GW of SCR and 10 GW of FGD capacity were

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[20] See, letter to Senator Carper from David Foerter, Executive Director of the Institute of Clean Air Companies (ICAC), November 3, 2010, http://www.icac.com/files/public/ICAC_Carper_Response_110310.pdf.

[21] The first of many NO_x SIP Call final regulations can be found at 63 FR 57356, October 27, 1998. The CAIR Rule is published at 70 FR 25162, May 12, 2005.

installed. Similarly, in the four years leading up to the compliance deadline for the Clean Air Interstate Rule. 75 GW of new FGD installations came on line[22]. Importantly, this increase in pollution control capacity was achieved without significant adverse impact on electric system reliability. Attachment 1 to this comment identifies the numerous states that have promulgated mercury limitations for EGUs. To our knowledge, no source has failed to comply with state deadlines for achieving these limitations, and no significant adverse impacts on electric system reliability were encountered as units were upgraded to meet state requirements.

The chart below illustrates the substantial reduction in mercury emissions that will result from implementation of the proposed standard. It also demonstrates that the proposed limits are technically feasible. Nearly half (154/339) of the existing coal-fired units for which EPA has data has already been shown to be able to meet the proposed mercury limits.

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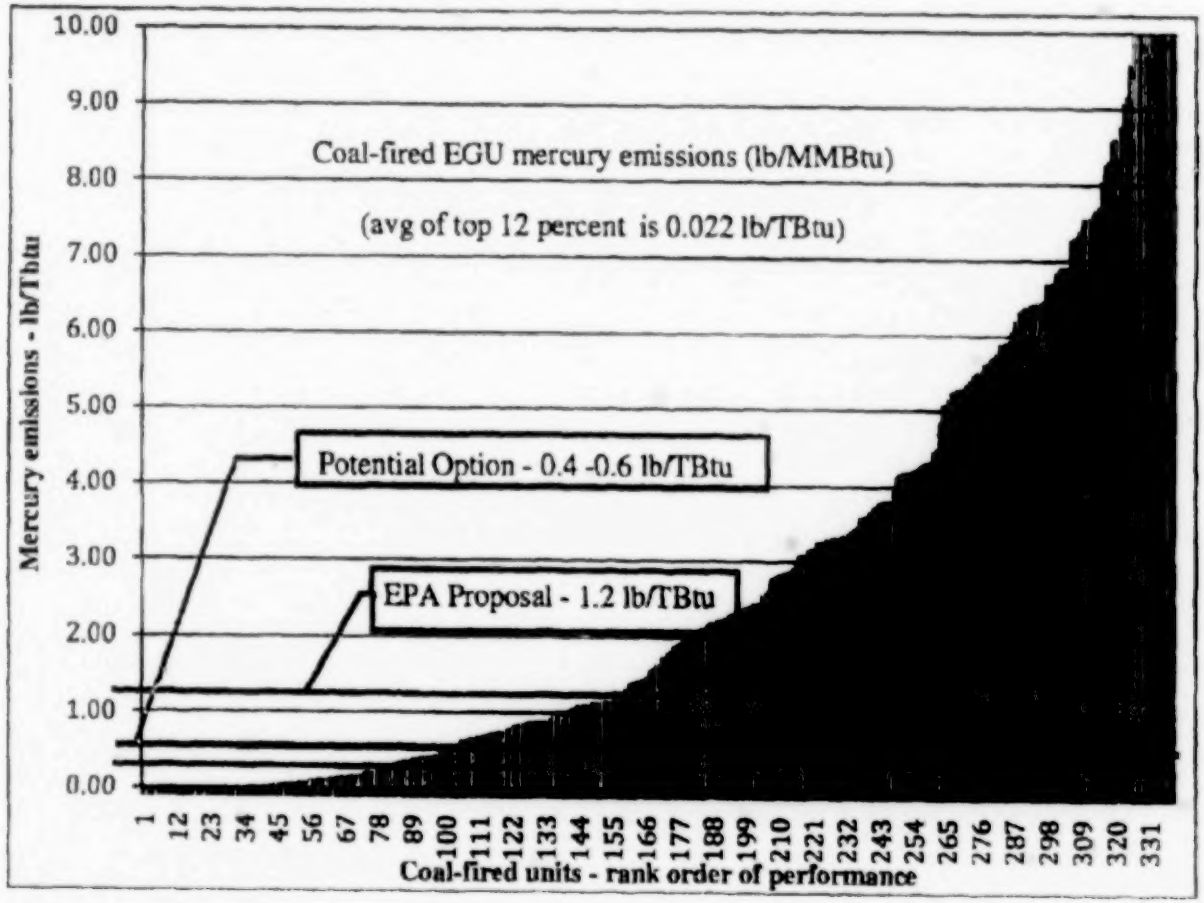
[22] This amount approximates the 83 GW of additional controls projected for the proposed rule. During the same period approximately 25 GW of additional SCR capacity was installed.

Chart 1. Coal-fired EGU Emissions by Unit



ESTABLISHING A MACT STANDARD

EPA acknowledges that ACI and FFs are well demonstrated technologies for mercury control, as are FGD/SCR combinations in certain instances. Similarly, EPA concludes that acid gas scrubbing is an effective and feasible strategy for controlling acid gas HAPs emissions and that FFs are effective in controlling metal PM emissions. EPA further agrees that the use of these technologies is common in this sector. If, as EPA assumes, the MACT floor for acid gas emissions will result in 290 MW of capacity to have some form of acid gas scrubbing, what is the rationale for not establishing these technologies as MACT? EPA has not explained why it has not chosen these technologies as MACT and has not discussed the adverse environmental impacts of failing to do so. As proposed, installed control capacity would not have to be fully utilized unless needed to meet the MACT floor-based limit. EPA's model assumes installation of controls whenever an existing unit currently exceeds the proposed limit, but operation only to the extent needed to meet the applicable limit. Establishing these technologies as MACT would have the effect of requiring installed capacity to be fully utilized and of requiring that the remaining 10 GW install these technologies. Since requiring full utilization of installed control devices is a highly cost effective means of reducing pollution, EPA should set forth a clear rationale for any final decision it makes on this issue and, at a minimum, require operators to reasonably minimize HAP emissions by fully utilitizing the capabilities of MACT control systems after installation.

States have years of experience with technology-based limits for mercury and other HAPs, including limits that are more stringent for many sources than EPA's proposed limits. See Attachment 1. EPA's primary obligation under section 112 of the CAA is to establish limits based on the application of the maximum achievable control technology. Secondarily, EPA must assure that those MACT limits are no less stringent than the MACT floor. EPA has focused nearly all of its analysis on calculations of the MACT floor and has not put forth a serious analysis addressing its obligation to propose and adopt technology-based MACT limits as required by section 112 of the CAA. From the plain language of the CAA, it would seem reasonable to expect that standards based on the **Maximum Achievable** Control Technology be no less stringent than those based on the **Best Available** Control Technology. We note that 65 of the 192 units in Subcategory 1[23] have demonstrated mercury removal efficiencies (based on fuelbound mercury content) of 95 percent or more and that several states have experience with standards as low as 0.6 pounds per trillion British thermal units ("lb/TBtu") or as high as 90- percent removal (from Hg concentrations at the inlet of the control device).

At the conclusion of the work of its member agencies as part of the 2001-2002 Clean Air Act

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[23] Subcategory 1 includes 1,030 units that combust bituminous and sub-bituminous coal. It is, by far, the largest and most important subcategory in the rulemaking. For this reason NACAA's comments focus on the regulations that affect this Subcategory.

Advisory Committee process,[24] NACAA recommended MACT limits of 0.4 to 0.6 lb/TBtu for mercury, with an alternate 90-percent control requirement. We also recommended a MACT limit of 0.015 pounds per million Btu ("lb/MMBtu") for PM and a 95-percent reduction requirement for SO_2 and HCl, based on the then-existing recorded BACT decisions. In addition, we recommended a 100 parts per million (ppm) MACT floor for CO as a surrogate for organic HAPs and suggested that a carbon monoxide ("CO") MACT limit, based on BACT levels, be established. NACAA further suggested that EPA consider short-term CO limits to address concerns relating to high emissions of hazardous products of incomplete combustion, due to poor combustion conditions during transient operating conditions. Since 2002, emission control performance has continued to improve while control costs have decreased and our understanding of the adverse effects of the HAPs emitted by fossil-fuel fired EGUs has increased. The emissions performance shown in the most recent testing demonstrates that the earlier NACAA recommendations were readily attainable.

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[24] The Utility MACT Working Group was formed by EPA in 2001 with an original constituency of six representatives of state, local and tribal agencies, eight representatives of environmental organizations and 16 representatives of affected sources, fuel producers, suppliers and labor groups. It was charged with providing input to EPA regarding federal air emissions regulations for coal- and oil-fired EGUs that would maximize environmental and public health benefits in a flexible framework at a reasonable cost of compliance. See, Working Group for the Utility MACT Formed Under the Clean Air Act Advisory Committee Subcommittee for Permits/New Source Reviews/Toxics, http://www.epa.gov/ttn/atw/combust/utiltox/utoxpg.html#CAAAC.

We stand by those earlier recommendations, except to recommend that EPA incorporate higher control efficiencies for mercury and SO_2 because of the advances in pollution control systems over the past decade and consider recent BACT determinations for PM and CO in setting MACT standards.

EPA has proposed to set MACT standards, as distinct from standards based on Generally Available Control Technology ("GACT"), for EGUs that have a heat capacity of greater than 250 million Btu/hr, even though such sources may not have been shown in the past to emit HAPS above the major source thresholds for these pollutants. EPA has specifically solicited comment on this proposal. Units of this size are indeed very large. Given the variability in HAPs emission rates and HAPs fuel content demonstrated by the record, it is clear that these units have the potential to emit substantial quantities of HAPs. For this reason NACAA supports application of MACT standards, rather than the less stringent GACT standards that would otherwise apply.

EMISSIONS OF ORGANIC HAPs

In the past, including in the recently promulgated ICI Boiler MACT that applies to a number of units similar to those in the EGU sector, EPA has employed the use of CO as a surrogate[25] for organic HAPs emissions and has adopted specific emission limits for CO from coal and oil-fired units,

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[25] EPA has employed CO as a surrogate for organic HAPs emissions in MACT standards for several other categories of sources, including ICI Boilers, hazardous waste incinerators, cement kilns and lightweight aggregate kilns.

and for dioxins and furans ("D/F"). In this instance EPA has elected not to employ CO as a surrogate and not to adopt emission limits for D/F or other organic HAPs. Instead, EPA has proposed a work-practice standard, a "tune up" that it acknowledges will not lead to measurable reductions in organic HAPs emissions. EPA has sufficient CO emissions data to establish a MACT floor, as it has in other sectors, and offers no rationale for its decision not to employ CO as a surrogate for organic HAPs. EPA then argues that emissions of a number of individual organic HAPs, such as benzene, were frequently below the detection limit ("BDL") at the very best performing units and therefore it is infeasible to establish or enforce an emission limitation. However, EPA has established procedures for addressing BDL values in calculating MACT floors and for other purposes. Moreover, the relevant factual issue is whether the emissions from the group at large are below detection limits, not just those of the very best performers.

EPA has not explained why it is infeasible to set a MACT limit or MACT floor using the CO data in its possession. EPA's Multi-pollutant Control Research Facility pilot-scale testing provides useful information as discussed in the proposal's preamble, but only describes the emission performance of units that presumably would comply with the CO MACT floor of less than 100 ppm that EPA would otherwise have calculated (if the agency had done such a calculation). This testing is cited by EPA as demonstrating that at low CO levels there is not a strong correlation between CO and organic HAPs emissions. However, these data provide no reason to

believe that reducing CO emissions to 100 ppm from much higher levels would not lead to meaningful reductions in organic HAPs from units currently emitting CO at much higher levels. Thus, this issue requires additional study. NACAA agrees that, if upon examination, there is no correlation between organic HAPs levels and elevated CO emissions, CO should not be used as a surrogate. In this event, however, EPA would be obliged to set a MACT floor and MACT limits for each of the individual organic HAPs of concern. .This approach has successfully been employed by states issuing new source MACT permits.

EPA makes the same argument with respect to D/F, but adds an argument that, in some instances, not all cogeners of dioxins have been found to be above detection limits in some samples. We do not understand the relevance of this argument. Dioxins are extremely hazardous chemicals and, while some congeners are more hazardous than others. the risk posed by dioxins is not dependent on all possible congeners being present.

ATTACHMENT 1
National Association of Clean Air Agencies
State/Local Mercury/Toxics Programs for Utilities[1]
May 1, 2011

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
Region 1			
Connecticut	Emissions from coal-fired electric generating units (EGUs) are limited to 0.6 lbs Hg/TBtu or a 90% reduction pursuant to section 22a-199 of the Connecticut General Statutes; compliance is determined through quarterly stack testing. The owner or operator of any coal-fired EGU is required to apply for and obtain a new source review permit pursuant to section 22a-174-3a(n) of the Regulations of Connecticut State Agencies.	Ric Pirolli 860-424-3450	CGS section 22a-199: http://www.cga.ct.gov/2007/pub/Chap446c.htm#Sec22a-199.htm RCSA section 22a-174-3a: http://www.ct.gov/dep/lib/dep/air/regulations/main/regs/sec3a.pdf
Maine	Waiting for federal MACT. Statutory limits applicable to all facilities in state – 35 lb/year, reduced to 25 lb/year January 2010.	Lisa Higgins (207) 287-7023 Lisa.Higgins@maine.gov	
Massachusetts	Adopted rule 310 CMR 7.29 requires 85% capture or 0.0075 lb/GW-hr by 1/1/2008 and 95% capture or 0.0025 lb/GW-hr by 10/1/2012. Averaging between units at the same facility allowed. Requires continuous Hg monitoring by 1/1/2008. Hg monitoring rulemaking replacing vacated Part 75 provisions under development. Expected mid 2011.	Marc Wolman (617) 292-5515 Marc.wolman@state.ma.us Sharon Weber (617) 556-1180 Sharon.weber@state.ma.us	http://www.mass.gov/dep/service/regulations/regsearch.htm#camr

[1] Blank state entries indicate that the agency did not provide information. This does not necessarily mean there is no program.

Please provide updates to this table to Mary Sullivan Douglas of NACAA at mdouglas@4cleanair.org.

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
New Hampshire	RSA 125-O Multiple Pollutant Reduction Program requires reductions in mercury and other pollutants from coal-burning EGUs (Merrimack 1 and 2 and Schiller 4, 5, and 6) by 2013. This statute requires installation of a wet FGD system (scrubber) at Merrimack 1 and 2 to control mercury emissions at the maximum sustainable rate by July 1, 2013. For all affected units, the aggregated total annual reduction in mercury emissions shall be a minimum of 80 percent relative to the 2003-2005 baseline mercury input level of the coal burned.	Pat North patricia.north@des.nh.gov	http://www.gencourt.state.nh.us/rsa/html/X/125-O/125-O-mrg.htm
Rhode Island	RI has no applicable EGUs.	Barbara Morin barbara.morin@dem.ri.gov	
Vermont	Vermont does not have any eligible EGUs.	Heidi Hales (802) 241-3848 Heidi.hales@state.vt.us	
Region 2			
New Jersey	Adopted state rule requires control efficiency of 90% or 3 mg/MW-hr by 12/15/2007, for coal-fired boilers of any size. A multi-pollutant approach can reduce the initial reduction required and extend compliance to 12/15/2012.	Sunila Agrawal (609) 292-9202 Sunila.Agrawal@dep.state.nj.us	http://www.state.nj.us/dep/aqm/Sub27.pdf
New York	On 1/27/07, NYSDEC promulgated 6NYCRR Part 246 for the control of mercury emissions from coal-fired electric utility steam generating units that incorporates a Phase I emission cap in the years 2010-2014 and beginning in 2015 establishes a unit-based emission limit for each applicable unit.	Steve DeSantis sxdesant@gw.state.ny.us	Details of the regulation can be found at: www.dec.state.ny.us/website/dar/air_regs.htm#recent Annual Stack testing was required for the years 2008 and 2009.

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	Phase I of the state proposal imposed annual facility-wide mercury emission limitations, based upon the state mercury budget EPA distributed to NY under the delisted CAMR. The annual facility-wide emission limitations will be in effect from 2010 to 2014. Starting in 2015, Phase II, in conjunction with other electric sector regulations such as the Regional Greenhouse Gas Initiative (RGGI) and EPA's Transport Rule, the state mercury regulation will establish a facility-wide emission limit for Hg 0.6 lbs Hg/TrBtu.		Hg CEMs have been installed and operating since 2009. New York has three facilities operating CEMs and one facility using Appendix K sorbent tube methodology.
Region 3			
Delaware	Delaware promulgated Regulation 1146 in December 2006. Regulation 1146 implements Hg emissions limits for Delaware's large (>25MW) coal-fired EGUs in two phases. Phase 1 became effective January 1, 2009 and implemented a Hg emission rate limit of 1.0 lb/TBTU, or 80% reduction from baseline. Phase 2 becomes effective Jan.1, 2013 and implements a Hg emissions rate limit of 0.6 lb/TBU, or 90% reduction from baseline. For coal-fired units subject to Regulation 1146, the regulation established annual Hg mass emissions caps for each individual unit (trading for compliance is not permitted). The Hg mass emissions caps are also implemented in a staged manner, with Phase 1 running 2009 through 2012, and a more stringent Phase 2 for 2013 and beyond.	Robert Clausen robert.clausen@state.de.us	Regulation 1146 may be found at: http://regulations.delaware.gov/AdminCode/title7/1000/1100/1146.shtml#TopOfPage

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
Maryland	Under Maryland's Healthy Air Act, which was signed into law on April 6, 2006, coal fired utilities must meet the following mercury emission limitations: (1) For the 12 months beginning Jan. 1, 2010 and ending with the 12 months beginning December 1, 2012 to December 1, 2013, each affected facility shall meet 12-month rolling average removal efficiency for mercury of at least 80 percent. (2) For the 12 months beginning Jan. 1, 2013 and thereafter, each affected facility shall meet 12-month rolling average efficiency of at least 90%. Implementing regs are found at COMAR 26.11.27.	Karen Irons 410-537-3230 kirons@mde.state.md.us	http://www.dsd.state.md.us/comar/comarhtml/26/26.11.27.03.htm
Pennsylvania	PA Mercury Rule was vacated by the Commonwealth Court. In response to the Department's appeal, the Pennsylvania Supreme Court affirmed the Commonwealth Court ruling on December 23, 2009. Pennsylvania will implement the final Federal Mercury MACT for the EGU sector.	Krishnan Ramamurthy kramamurth@state.pa.us	
Virginia	Virginia is awaiting the new federal MACT for EGUs	Patty Buonviri Patricia.buonviri@deq.virginia.gov	
West Virginia	With the WV Code requirement to be no more stringent than federal rules, and the results of the state "Mercury Study", we are awaiting the promulgation of the new federal MACT rule for EGUs. However, certain EGUs are subject to consent orders (state or federal) requiring the use of SCR's for NOx control all year. Co-beneficial HAP reduction may occur as a result.	Laura Crowder Laura.M.Crowder@wv.gov	

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
Region 4			
Alabama	Alabama is awaiting the new federal MACT for EGUs.	James Carlson (334) 271-7875 jhc@adem.state.al.us	
Florida			
Georgia	Georgia is awaiting new federal MACT. State rule 391-3-1-.02(2)(sss) "Multipollutant Control for Electric Utility Steam Generating Units" requires installation and operation of SCR and flue gas desulfurization (which gives co-benefit reduction for mercury) on specified schedule. This rule also requires the implementation of sorbent injection technology on four units at Georgia Power Plant Scherer for mercury control. State rule 391-3-1-.02(2)(ttt) "Mercury Emissions from new Electric Generating Units" requires use of best available control technology to control mercury emissions from new ESGUs. New information (March 2, 2010): State rule 391-3-1-.02(2)(uuu) "SO2 Emissions from Electric Utility Steam Generating Units" specifies numerical limits for SO2 controls – this should provide some level of reduction in mercury emissions.	Karen Hays karen.hays@dnr.state.ga.us Jim Kelly james.kelly@dnr.state.ga.us	www.georgiaair.org/airpermit/html/regrules/regrules.htm
Kentucky	Kentucky is awaiting the new federal MACT.	John Lyons john.lyons@ky.gov	
Louisville, KY	Louisville developed and is implementing a program	Paul Aud	www.louisvilleky.gov/APCD/STAR/

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	for Strategic Toxics Air Reduction (STAR) which addresses toxics from every source sector	paul.aud@louisvilleky.gov	
Mississippi	Mississippi is awaiting the new federal MACT.	BJ Halley B_J_Halley@deq.state.ms.us	
North Carolina	North Carolina is realizing major reductions of mercury emissions from coal-fired boilers as a direct cobenefit of the N.C. Clean Smokestacks Act in 2002 (G.S. 143-215.107D). NC anticipates additional reductions of atmospheric mercury as a result of CAIR. NC mercury rule for coal-fired EGUs requires a mercury emission control plan from each utility on January 1, 2013 that identifies the technology proposed for use at each unit owned or operated by the utility; the schedule for installation and operation of mercury controls at each unit; and shall identify any units that will be shut down. Any unit that has not installed controls as specified in an approved mercury control plan by December 31, 2017 shall be shut down.	Michael Abraczinskas (919) 715-3743 michael.abraczinskas@ncdenr.gov Joelle Burleson (919) 733-1474 Joelle.burleson@ncdenr.gov	http://daq.state.nc.us/rules/rules/D2511.pdf
South Carolina	South Carolina developed a state version of the CAMR, which has now been removed from our regulations (as of May 2010). After the federal CAMR was vacated, we entered into a Memorandum of Agreement with our state's utilities to either install Hg monitors or test coal fired units in SC by July	Robert Brown (CAMR contact) (803) 898-4105 prownrl@dhec.sc.gov Heinz Kaiser (Air Toxics	http://www.dhec.sc.gov/environment/baq/CAMR.aspx

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	2009 to provide source specific Hg emission data. As with other states we are seeing Hg reductions through the implementation of the NOx SIP call and CAIR controls. We are relying on 112(g) for new (EGU) sources and are waiting on the new federal MACT for further Hg reductions. We are relying on 112(g) for new (EGU) sources and are waiting on the new federal MACT for further Hg reductions.	contact) (803) 898-4089 kaiserh@dhec.sc.gov	
Tennessee	TN is waiting for promulgation of the new federal MACT.	Travis Blake (615) 532-0617 Travis.blake@state.tn.us Elizabeth Peeler (615) 532-9200	
Region 5			
Illinois	Illinois has adopted a state rule regulating mercury (Hg) emissions from coal fired power plants, beginning in July 2009. The basic components of the rule are: PHASE I: (thru December 31, 2012) 1. 90% reduction from input Hg emissions or an output based emission standard of 0.008 lb/GW-hr on a system-wide basis. (Hg reduction of at least 75 % input, or meet a Hg emission standard of 0.02 lb GW-hr output basis, required on a plant by plant basis.)	Laurel Kroack 217-785-4140 laurel.kroack@illinois.gov Jim Ross jim.ross@illinois.gov	The Illinois Hg rules (which include the multi-pollutant standards and combined pollutant standards) can be found at http://www.ipcb.state.il.us/SLR/IPCBandIEPAEnvironmentalRegulations-Title35.asp. 35 Ill. Adm. Code Part 225, "Control of Emissions from Large Combustion Sources," Subparts B & F.

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	2. A Temporary Technology Based Standard (TTBS) available for up to 25% of a system's capacity, allowing the system to select units to be "excused" from the specified Hg reduction rates. To qualify for a TTBS, the eligible units must have ACI and must inject sorbent at a specified rate. TTBS available until June 1, 2015. PHASE II: (beginning January 1, 2013 and beyond) 1. 90% reduction from input Hg emissions or an output based emission standard of 0.008 lb/GW-hr on a plant by plant basis. 2. A Temporary Technology Based Standard (TTBS) available for up to 25% of a system's capacity, allowing the system to select units to be "excused" from the specified Hg reduction rates. To qualify for a TTBS, the eligible units must have ACI and must inject sorbent at a specified rate. TTBS available until June 1, 2015. 3. ALTERNATIVE – MPS & CPS: Systems may opt-in to a multi pollutant compliance approach (MPS) and combined pollutant standard approach (CPS) for SO2, NOx and Hg. Installation of Hg controls designed to meet 90% removal and a minimum sorbent injection rate through 2014 required on at least 96% of capacity. Systems participating in an MPS or CPS may exempt units representing 4% of capacity or less from Hg control until 12/31/2012. Those units must install Hg control and meet minimum sorbent injection rates		

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	beginning January 1, 2013. Beginning January 1, 2015, MPS & CPS systems must meet 90% reduction from input Hg emissions or an output based emission standard of 0.008 lb/GW-hr on a plant by plant basis. (The units representing 4% or less of capacity do not have to get 90% reduction.) The MPS and CPS for SO2 and NOx vary by system—based on age of units, coal type, interim and final emission rates and compliance deadlines.		
Indiana	Indiana is awaiting the new federal MACT.	Susan Bem sbem@idem.in.gov	
Michigan	Michigan's state rule requires mercury reductions from coal-fired electric generating units starting January 1, 2015. The basic components include three compliance options: 1. A minimum of 90% reduction* from baseline input mercury levels or an output-based emission standard of 0.008 lb/GW-hr*. 2. A multi-pollutant compliance demonstration project which must achieve 75% reduction* from baseline input mercury levels along with significant reductions in nitrogen oxides and sulfur dioxide. 3. Very Low Mass Emitting (VLME) unit that is limited to 9 pounds of mercury per 12-month rolling time period with an alternative compliance demonstration project. * 12-month rolling average basis.	Technical contact: Julie Brunner 517-373-7088 brunnerj1@michigan.gov Administrative rules contact: Teresa Cooper 517-335-2247 coopert@michigan.gov	Michigan's mercury rules - Part 15, Part 10, and Part 11 can be found at: http://www.deq.state.mi.us/aperats/roc_collapsible_2.shtml

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	The rules include the compliance options, technical and economic exceptions, monitoring, testing, record keeping, and implementation. Other HAPs (including mercury) are currently regulated under the state toxics rules.		
Minnesota	State Legislation in 2006 requires the state's three largest electric power plants (6 units) to reduce mercury emissions 90% by 2015. In 2005 these three plants emitted 70% of the sector's emission. Remaining facilities emitting greater than 5 lb/year will reduce by 70-90% by 2025, mostly sooner. This reduction will be accomplished by proposed state rule.	Primary contact: Anne Jackson 651-757-2460 anne.jackson@state.mn.us Alternate: Ned Brooks 651-757-2247 ned.brooks@state.mn.us	More information about 2006 legislation: http://www.pca.state.mn.us/publications/p-p2s4-06.pdf Mercury air emissions strategy: http://www.pca.state.mn.us/air/mercury.html
Ohio	Ohio is waiting for the new federal MACT for EGUs as the replacement for Ohio's rescinded CAMR program regulation.	Lee F. Burkleca (614) 728-1344 Lee.burkleca@epa.state.ohio.us	
Wisconsin	A revised mercury rule became effective December 1, 2008. Large coal-fired power plants (those with a nameplate capacity of 150 Megawatts (MW) and greater) must achieve a 90% mercury emission reduction through one of two compliance paths. 1) 90% mercury reduction or limit the concentration of mercury emissions to 0.0080 pounds of mercury per gigawatt-hour by January 1, 2015.	Marty Burkholder 608-264-8855 martin.burkholder@wisconsin.gov Tom Karman (608) 264-8856 thomas.karman@wisconsin.gov	www.legis.state.wi.us/rsb/code/nr/nr446.pdf

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional information or Comments (including link to regulations)
	2) 90% mercury reduction by January 1, 2021 under a multipollutant option that requires a nitrogen oxides (NO_x) emission standard of 0.07 pounds of NO_x per million BTU and a sulfur dioxide (SO_2) emission standard of 0.10 pounds of SO_2 per million BTU by January 1, 2015. An interim mercury reduction goal targets January 1, 2015 to achieve a 70% mercury reduction or limiting the concentration of mercury emissions to 0.0190 pounds of mercury per gigawatt-hour. Beginning January 1, 2018 an 80% mercury reduction or limiting the concentration of mercury emissions to 0.0130 pounds of mercury per gigawatt-hour must be achieved. The percent reduction standard is measured from the mercury content in the coal combusted. Four major utilities, Dairyland Power Cooperative, We Energies, Wisconsin Power & Light Company and Wisconsin Public Service Corporation, must reduce their mercury emissions 40% by Jan. 1, 2010. Small coal-fired power plants (> 25 MW and < 150 MW) must reduce their mercury emissions to a level defined as Best Available Control Technology (BACT) by January 1, 2015.		
Region 6			
Arkansas	AR is awaiting further direction from EPA before	Elizabeth Sartain	

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	proceeding with regulations to control mercury emissions from EGUs.	(501) 682-0719 Sartain@adeq.state.ar.us	
Louisiana			
New Mexico	New Mexico is waiting for the new federal MACT.	Bob Spillers Robert.spillers@state.nm.us	
Oklahoma	Oklahoma is awaiting the new federal MACT	Cheryl Bradley (405) 702-4216 Cheryl.bradley@deq.ok.gov	
Texas			
Region 7			
Iowa	Iowa is waiting for a new federal MACT rule but has adopted alternative mercury monitoring requirements for EGUs. The alternative requirements are for mercury monitoring only (they do not establish emission limits or control requirements) and became effective in November 2009.	Christine Paulson (515) 242-5154 christine.paulson@dnr.iowa.gov	
Kansas	KS is waiting for a new federal MACT rule.	Miles Stotts mstotts@kdheks.gov	Using case-by-case for new sources as needed.
Missouri	MO is awaiting the promulgation of the new federal MACT rule for EGUs.	Aaron Basham 573 751-4817 aaron.basham@dnr.mo.gov	New sources reviewed on a case by case basis.
Nebraska	NE is waiting for a new federal MACT rule.	Melissa Ellis melissa.ellis@nebraska.gov	Using case-by-case for new sources as needed.
Region 8			
Colorado	State-only rule sets Hg standards for existing, new, modified and reconstructed coal-fired power plants on a rolling 12-month average basis, exempting low emitters and new units with existing permits in place. Existing units are subject to the following:	Dena Wojtach (303) 692-3147 dena.wojtach@state.co.us	Rule adopted on 2/5/07; revised 10/18/07 to address new, modified and reconstructed units; revised 11/20/08 to incorporate Hg monitoring. See Regulation 6, Part B, Section VIII

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)

	• 2012: Pawnee and Rawhide 0.0174 lb/GWh or 80% inlet Hg capture;
	• 2014: 0.0174 lb/GWh or 80% inlet Hg capture; and
	• 2018: 0.0087 lb/GWh or 90% inlet Hg capture.
	New, modified and reconstructed units are subject to:
	Modified units with existing permits in place:
	• Upon startup: Comanche 3 – 0.020 lbs/GWh;
	• Upon startup: Lamar 4 – Bit. Coal 0.020 lbs/GWh or Subbit. Coal 0.097 lbs/GWh; and
	• Upon startup: Craig 3 – 0.066 lbs/GWh.
	Future modified units:
	• Upon startup if <12/31/14: 0.0174 lb/GWh or 80% inlet Hg capture.
	• Upon startup if >1/1/15: 0.0087 lb/GWh or 90% inlet Hg capture.
	Future new or reconstructed units:
	• Upon startup: Best Available Mercury Control Technology Standard.
	  o 95% Hg capture goal; and
	  o 90% Hg capture minimum.
	
	The rule provides for an Alternative Standard (a.k.a "soft landing") to be established if a unit demonstrates to Colorado that it cannot meet the applicable standard. This rule also allows averaging of units at the same plant, except for new and reconstructed units. Finally, this rule largely incorporates CAMR's Hg monitoring requirements, including the 1/1/09 monitoring date, with the some
			(http://www.cdphe.state.co.us/regulations/airregs/100108stationarysources.pdf).
			
			Hg monitoring exceptions:
			• Units that shut down prior to January 1, 2014 are exempt from Hg monitoring requirements.
			• Units that have Hg permit terms and conditions as of November 20, 2008 shall follow their permit requirements specific to Hg monitoring.
			• Units are not required to use data substitution routines, and instead report measured actual Hg emissions to Colorado.
			• Units are not required to follow Electronic Data Reporting requirements, and instead submit written quarterly and annual summary reports to Colorado.
			• Units are not required to follow the NIST Traceability Protocol, relating to Hg CEMS certifications. NIST Traceability Protocol requirements are not applicable in Colorado until EPA finalizes the protocol and Colorado adopts those requirements.
			Units are not required to follow CEMS QA/QC testing, reporting and recordkeeping of Hg related monitoring equipment (stack flow monitor, CO2 monitor, moisture monitor)

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
	exceptions (see comments).		already regulated under the Acid Rain Program.
Montana	Montana finalized a state rule for mercury control from EGUs in October of 2006. It requires the following starting January 1, 2010: • Compliance with 0.9 lb/TBtu mercury limit, calculated as a 12-month rolling average for non-lignite facilities or • 1.5 lb/TBtu mercury limit for lignite facilities • application for and approval by MT DEQ of a mercury control strategy (applications required by Jan. 2009; all but one have been approved and finalized, the last will be final on 7/16/09). By July 1, 2011, facilities may apply for an alternative emission limit (AEL, with a ceiling in rule) if unable to meet original emission limit. All EGUs are subject to an every 10-year mercury BACT analysis (EGUs with approved AELs must provide BACT analysis by January 1, 2014 instead of waiting the full ten years initially)	Debbie Skibicki (406) 444-1472 dskibicki@mt.gov	Regulation: Administrative Rules of Montana 17.8.771 http://deq.mt.gov/dir/legal/Chapters/CH08-07.PDF With the federal vacatur, MT has put significant work with its regulated community into developing Hg monitoring strategies that are effective and make sense out of what is left of Part 75. All of the EGU permits now contain mercury-monitoring attachments that will probably be refined over time.
North Dakota	ND is awaiting the promulgation of the new federal MACT rule for EGUs.	Tom Bachman (701) 328-5188 tbachman@nd.gov	
South Dakota			
Utah			
Wyoming			
Region 9			
Arizona			

State or Local Agency	State's strategy for addressing emissions of mercury and other HAPs from EGUs following vacatur of Clean Air Mercury Rule (e.g., we have implemented or are implementing our own state rule [please describe briefly]; we are developing a state rule [please briefly describe]; we are awaiting the promulgation of the new federal MACT rule for EGUs.)	State/Local Contact Information	Additional Information or Comments (including link to regulations)
California	California is waiting for the promulgation of the new federal MACT rule for EGUs.	Todd Wong (916) 324-6031 twong@arb.ca.gov Duc Tran (916) 322-5558 dmtran@arb.ca.gov	
Hawaii	Rules were never adopted. Awaiting further guidance for implementing 112(j) requirements.	Scott Takamoto (808) 586-4200, scott.takamoto@doh.hawaii.gov	
Nevada	The state recently (effective 7/21/10) repealed the state program that was based on the federal CAMR, and is awaiting a new federal MACT rule. Nevada never got to implement the state program.	Adele Malone amalone@ndep.nv.gov	
Region 10			
Alaska	Awaiting new MACT rules. Permittees with affected sources have adopted the vacated MACT terms and conditions until new rules become adopted.	Jim Baumgartner [907] 465-5108 Jim.baumgartner@alaska.gov	Awaiting further guidance for implementing 112(j) requirements
Idaho	Idaho has no applicable EGUs.	Carl Brown (208) 373-0206 Carl.brown@deq.idaho.gov	
Oregon			
Washington	We are awaiting the promulgation of the new federal MACT rule for EGUs.	Elena Guiltoil 360-407-6855 guiltoil.elena@ecy.wa.gov	

State of New Jersey
Department of Environmental Protection
Environmental Management
Division of Air Quality
P.O. Box 420
Mailcode 401-02
Trenton, NJ 08625-0027
Phone: 609-984-1484
Fax: 609-633-8236

Chris Christie	Kim Guadagno	Bob Martin
Governor	Lt. Governor	Commissioner

August 4. 2011

EPA Docket Center (EPA/DC)
Environmental Protection Agency, Mailcode: 2822T
Attention: EPA- HQ-OAR- 201 1- 0044 (NSPS action) and EPA- HQ-OAR- 2009- 0234 (NESHAP action)
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

RE: Emissions from Electric Utility Steam Generating Units Docket fD No. OAR- 20 11-0234 (NESHAP Action) and OAR-2011-0044 (NSPS Action)

Dear Sir or Madam:

Thank you for the opportunity to comment on the May 3, 2011 proposal by the United States Environmental Protection Agency (USEPA), to set national emission standards for hazardous air pollutants (NESHAP) for new and existing coal and oil- fired electric utility steam generating units

(EGUs) under Clean Air Act (CAA or the Act) section 112(d) and revised new source performance standards (NSPS) for fossil fuel-fired EGUs under CAA section Ill (b).

New Jersey supports this effort by the USEPA to set standards to address its finding in 2000, that it is "appropriate and necessary" to regulate emissions of hazardous air pollutants (HAPs) from power plants. The proposed USEPA standards are achievable. Most of New Jersey's coal-fired power plants already have installed modem air pollution controls that meet these proposed standards, and we are pleased that USEPA is acting to reduce emissions of poorly controlled plants in other states. Air pollution from sources in other states is a major contributor to poor air quality in New Jersey.

Setting lower emission standards for mercury, other toxic metals, acid gases, and total particulates, is a practical and effective way to minimize the impact of hazardous

[Page 2]
pollutants on public health and the environment. Better particulate control for many older coal- fired power plants is a core measure for the control of HAPs. In addition to the control of particulate HAPs, such as lead, cadmium, arsenic, and chromium, good particulate control enables more cost effective control of certain gaseous HAPs, including mercury and hydrochloric acid.

Specific recommendations to improve the NESHAP and NSPS for these major sources of air pollution are

provided in the enclosure. I would like to highlight four of these recommendations.

1. USEPA should require that the air pollution control systems needed to achieve these emission standards be operated in such a manner to reasonably minimize HAP emissions after construction. New Jersey included such a requirement in its mercury rules.

2. EPA should set an emission limit for carbon monoxide to provide a readily measurable indicator of good combustion, which is necessary to avoid high levels of organic HAP emissions.

3. EPA should require that states set maximum allowable hourly heat inputs for each unit and that testing to determine compliance be conducted at these maximum rates. This heat input limit is especially important for pollutants which do not have a continuous monitor and are tested infrequently (such as particulate HAPs).

4. The test data EPA used for BL England to calculate the mercury MACT appears to be incorrectly high. Attached is a summary of the quarterly test data for the last 3 years.

We appreciate your consideration of our comments. If you have any questions, please contact me by telephone at (609) 984-1484 or by e-mail at bill.o'sullivan@dep.state.nj.us to discuss these comments.

Sincerely,
William O'Sullivan,

William O'Sullivan, P.E.
Director

c: (w/enclosure) 2 copies
EPA Docket Center (EPA/DC)
Environmental Protection Agency, Mailcode: 2822T
Attention: EPA-HQ-OAR-2011-0044 (NSPS action) and EPA-HQ-OAR-2009-0234 (NESHAP action)
1200 Pennsylvania Avenue, N.W.

* * *

[Page 4]

DETAILED COMMENTS

1. Particulate HAPs

The Department supports the proposed particulate matter emission limit for existing coal-fired EGUs. Better particulate control for many older coal-fired power plants is a core measure for the control of HAPs. In addition to the control of particulate HAPs, such as lead, cadmium, arsenic, and chromium, good particulate control enables more cost effective control of certain gaseous HAPs, including mercury and hydrochloric acid.

a. Total particulate matter emission limits in the proposed NSPS at 40 CFR Part 60.42Da(f) should be the same as the proposed NESHAP at 40 CFR Part 63.9991(a)(l) Table 1 through 3.

b. The particulate matter definition in the proposed rules includes the sum of the total filterable and total condensables? NJ supports limiting emissions of total filterable and total condensable particulate

matter, but recommends the nomenclature be clarified to avoid confusion.

c. The particulate filterable temperature is defined as 320F ± 2SF, which is the temperature currently used for non-sulfate filterable particulate matter testing. Is this because the sulfate is to be counted with the condensables? This is different than most EPA testing (248F ± 2SF), so the filterable particulate results measured under these new requirements would likely be lower than what would be currently measured. Since the limits are for the total particulate matter (filterable and condensable) the total catch should in theory be the same regardless, but this would impact the PM CEMS (if used) since they will be measured on the filterable only. Also, companies would have to test separately for compliance with different federal particulate limits based on these temperature differences, adding to the testing workload.

d. Similarly, the filter temperature for metals testing is defined the same way (320F + 2SF) instead of the current practice (248F + 25F.) The proposed rules mention determining filterable metals separately from total metals, and as with PM, this impacts limits set for mercury CEMS or sorbent monitoring (if used) since particulate mercury is not measured by these methods. In this case, there will be higher mercury results on the CEMS or sorbent monitoring since the higher filter temperature would allow more mercury to pass through the filter. As long as EPA adopts stringent PM limits, we can be assured that particulate mercury emissions will not be significant. In such a case, monitoring gaseous mercury should

be sufficient and the filter temperature should not change the gaseous mercury results significantly.

[Page 5]
2. <u>Acid Gas HAPs</u>

The proposal appropriately allows a unit to use hydrochloric acid (HCl) or sulfer dioxide (SO_2) as a surrogate for acid hazardous air pollutants emissions.

a. While the proposed sulfur-dioxide surrogate standard (0.20 lbs/MMBtu) is not as stringent as the New Jersey 2012 emission standard (0.15 lbs/MMBtu 30-day average), it requires a good scrubber that should meet the maximum achievable control technology (MACT) requirements. Recent data demonstrated that operation of spray drier flue gas desulfurization at PSEG Fossil LLC's Mercer Generating Station Units I and 2 have achieved compliance with New Jersey's SO_2 emission rate using 2% coal (see attached test data).

b. Compliance with the proposed hydrochloric acid limit may not guarantee the best sulfur dioxide controls. Additional sulfur dioxide emission reductions may be needed to meet a revised fine particulate matter health and welfare standard if the selected hydrochloric acid controls do not sufficiently reduce sulfur dioxide emissions. The USEPA should encourage facilities to install the best controls as soon as possible to provide the public health benefits for all pollutants sooner. The USEP A should make it clear that Dry Sorbent Injection may be a good short term hydrochloric acid emission reduction measure,

but over the longer term, better control of sulfi.tt dioxide may be required.

3. Mercury

New Jersey has adopted achievable mercury emission limits for coal-fired power plants. New Jersey rules have been in effect since 2004, and compliance has been demonstrated. New Jersey has a combination mercury standard with a mercury control efficiency of 90% or a mercury concentration limit of 3 mg/MWhr, annual average, based on net energy output. A facility has a choice of either limit. The 3.0 mg /MWhr concentration limit is equivalent to 0.66 lbs per trillion BTU for a coal boiler with a 10,000 BTU per KW-hr heat rate.

a. The USEPA's proposed mercury emission limit of 1.2 lb/trillion BTU (equivalent to 5.45 mg/MWhr) is not as stringent as New Jersey mercury concentration limit of 3 mg/MWhr. If the MACT standard included an alternative limit of 90 percent control of mercury emissions, this would enable the concentration limit to be lower than the level proposed by USEPA and still allow high mercury coal to be burned with good air pollution control.

b. The USEPA's selected format for the standard of "lb/MWh gross" should be changed to "lb/MWh net" to encourage improvement in overall energy efficiency at new electric utility plants. Use of a net MWhr-based standard should in the long run lead to lower mercury emissions from the electricity generation sector per a given amount of useful electricity production.

Comparison of proposed EPA MACT emission limits for existing coal fired EGUs with test data on well controlled units in New Jersey				Actual test 2011	Actual test 2011
Pollutants	Existing EGUs		Remarks	PSEG Mercer 1	PSEG Mercer 2
	Proposed EPA Limits*	NJ Rule limits			
SO2 (lb/MM Btu)	0.20	0.15	EPA SO2 limit is an alternative to the HCl limit.	0.11	0.05
OR					
Hydrogen chloric acid, HCl, (lb/MM Btu) ***	0.002				0.00
Total Particulate Matter, PM Lb/MM Btu****	0.03	0.03	EPA PM limit is an alternative to the total non-Hg HAP metals	0.063	0.008
OR					
Total non-mercury HAP metals, (Lb/Tbtu)	0.040				
OR, individual HAPS metals (except Hg)					
Antimony (Lb/Tbtu)	0.6				No data
Arsenic (Lb/Tbtu)	2				0.00
Beryllium, (Lb/Tbtu)	0.2				0.00
Cadmium (Lb/Tbtu)	0.3				0.00
Chromium (Lb/Tbtu)	3				0.64
Cobalt (Lb/Tbtu)	0.8				0.00
Lead (Lb/Tbtu)	2				0.32
Manganese (Lb/Tbtu)	5				1.61
Nickel (Lb/Tbtu)	4				1.06
Selenium (Lb/Tbtu)	6				0.42
Mercury (Lb/TBtu)	1	3.00 mg/MWh or 90% control efficiency by 12/15/2007	converts to 0.66 lb/Tbtu		0.00
Trillion British Thermal Unit (Tbtu)					
*Values are from Table 2 Existing EGUs , page 850/946					
** Values are from Table 16 page #465-466/946 and Table 1 of Page #846/946					
***A source has option to demonstrate compliance with HCl limit by meeting a 0.002 lb/MM Btu HCl or by meeting 0.2 lb/MMBtu SO2. SO2 is a suitable surrogate for the acid gas HAP, it could be used as an alternate to the HCl standards for EGUs with Flue Gas Desulfurization (FGD)					

installed and operated at normal capacity. SO2 limits are 30 day rolling average.

****EPA proposed PM limit includes condensable. NJ allowable does not include condensable.

* Results are below the detection limit. To lower the detection limit, sampling time will need to be increased.

SO2 PSEG Mercer 1 and 2 were tested with FGD
scrubber in Nov 2010.

{Comments of Environmental and Public Health Groups on Proposed Rule (submitted Aug. 4, 2011) (Docket No. EPA-HQ-OAR-2011-0044-5715)(excerpt: Chapter I)}

I. There Are Significant Adverse Public And Environmental Health Effects Associated With The Air Pollutants Regulated Under This Proposed Rule

A. Hazardous Air Pollutants from Power Plants Cause Wide-ranging Health Harm[1]

During the process of burning coal, power plants emit highly toxic chemicals that threaten human health through the air we breathe, the water we drink, and the food we eat. These pollutants include: corrosive substances (acid gases, such as hydrogen chloride and hydrogen fluoride); carcinogens (formaldehyde, benzene, toluene, and other compounds); organic carbon-based toxins (formaldehyde, dioxins, furans); metals (such as arsenic, nickel, and beryllium); neurotoxins (such as mercury and lead); polycyclic aromatic hydrocarbons (PAH); and radioactive materials (such as radium and uranium).[2,3]

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[1] The studies and references cited in footnotes 2-74 are incorporated by reference, and provided (or abstracts are provided) with the comments submitted August 4: Letter to Administrator Lisa Jackson, U.S. EPA, RE: EPA-HQ-OAR-2009-0234 and EPA-HQ-OAR-2011-0044, by the American Academy of Pediatrics, American Heart Association, American Lung Association, *et al.*

[2] U.S. Environmental Protection Agency (EPA). 2007. National Emissions Inventory (NEI) 2002: Inventory Data: Point Sector

According to the most current data in the National Emissions Inventory, coalfired power plants produce over 386,000 tons of 84 separate hazardous air pollutants from over 440 plants in 46 states.[2] These plants produce 40 percent of all hazardous air pollutants released from domestic industrial sources, more than any other industrial source. In addition, the combustion of coal to generate electricity produces 76 percent of the total volume of acid gases, 60 percent of arsenic, and 46 percent of mercury released into the atmosphere.[2]

Research has shown that these toxins are especially dangerous because of the harm they can cause to the circulatory, respiratory, nervous, endocrine, and other essential life systems within humans. Toxic emissions can even cause developmental disorders and premature death. Pollutants such as acid gases, mercury, and sulfur dioxide, have immediate impacts on people, neighborhoods, and towns within the immediate vicinity of a power plant. However, other pollutants, such as dioxins and metals, can travel much farther from the pollution source. These pollutants, which adhere to fine particles, can remain in the air for more than a week and be carried by winds to distant locations. This makes toxic air pollution dangerous to

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Data – ALLNEI HAP Annual 01232008. Web Link: http://www.epa.gov/ttn/chief/net/2002inventory.html#inventory data [Accessed 11 January 2011].

[3] Agency for Toxic Substances and Disease Registry (ATSDR). 2011. Toxic Substances Portal: Toxicological Profiles. Washington, DC, USA: ATSDR. Web Link: http://www.atsdr.cdc.gov/toxprofiles/index.asp [Accessed: 18 February 2011]. ("ATSDR, 2011a").

public health and human health both near to and far from coal-fired power plants.[4]

We agree with the strong evidence that EPA provides in the proposed rule to support their decision that regulation of coal- and oil-fired power plants is both appropriate and necessary to protect public health. Not only is there clear evidence that the harm from mercury and methylmercury continues, but recognized carcinogens and other toxics that cause or increase risk of cardiovascular, respiratory, and other acute and chronic systemic damage are also emitted by power plants. The cleanup of toxic air pollution from power plants is necessary for the protection of public health, appropriate for EPA to undertake, and long overdue.

1. There is Evidence that These Toxics Pose Serious Threats to Health and Must Be Reduced

a. Acid Gases (Including Hydrogen Chloride, Hydrogen Fluoride, Chlorine)

Strongly corrosive gases produced by coal-fired power plants include two of the largest volume toxic emissions by ton: hydrogen chloride and hydrogen fluoride.[2] Acid gas vapors can harm the respiratory tract by reacting with the moisture and tissues on the upper airways (due to their solubility in water) and bind to particles to further travel to the alveolar

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[4] U.S. Environmental Protection Agency (EPA), 2009. Inte2grated Science Assessment for Particulate Matter, EPA 600/R-08/139F. Available at http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=216546.

regions of the lung.[5] Chlorine is another toxic acid gas produced in coal combustion.[6]

Large-scale epidemiological studies have revealed a strong linkage between acid gases (bound to particles or as aerosols) and adverse respiratory effects. A study of 13,000 children in 24 cities found that the strong acid aerosols associated with episodes of bronchitis and reduced lung function and acid aerosols were associated with asthma and related symptoms in children.[7,8] Another recent study also found that acid gases and particle pollution were associated with reduced lung function.[9] Hydrogen

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[5] U.S. Environmental Protection Agency (EPA). 1998. *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress, Volume 2. Appendices (EPA-453/R-98-004b).* Research Triangle Park, NC, USA: EPA, Office of Air Quality Planning and Standards, available at http://www.epa.gov/ttncaaa1/t3/reports/eurtc2.pdf.

[6] U.S. Environmental Protection Agency (EPA). 2011. Regulatory Impact Analysis for proposed Air Toxics Rule, Office of Air Quality Planning and Standards, Research Triangle Park, NC. Web link: http://www.epa.gov/ttn/ecas/regdata/RIAs/ToxicsRuleRIA.pdf [Accessed 16 June 2011].

[7] Raizenne M, Neas LM, Damokosh AI, Dockery DW, Spengler JD, Koutrakis P, Ware JH, Speizer FE. 1996. Health Effects of Acid Aerosols on North American Children: Pulmonary Function. *Environmental Health Perspectives* 104(5):506-514.

[8] Dockery DW, Cunningham J, Damokosh AI, Neas LM, Spengler JD, Koutrakis P, Ware JH, Raizenne M, Speizer FE. 1996. Health Effects of Acid Aerosols on North American Children: Respiratory Symptoms. *Environmental Health Perspectives* 104(5):500-504.

[9] Gauderman WJ, Avol E, Gilliland F, Vora H, Thomas D, Berhane K, McConnell R, Kuenzli N, Lurmann F, Rappaport E, Margolis H, Bates D. 2004. The effect of air pollution on lung

chloride is a strong acid gas that reacts with moisture to form hydrochloric acid. Hydrogen chloride intensely irritates the mucous membranes of the respiratory system. At high concentrations, hydrogen chloride can cause swelling and spasms in the throat and suffocation. In addition, inhaled hydrogen chloride can lead to a chemical- or irritant-induced form of asthma called Reactive Airway Dysfunction Syndrome (RADS).[10] Both hydrogen chloride and hydrogen fluoride can irritate the eyes, nasal passages, and lungs.[11,12]

Colorless hydrogen fluoride gas poses serious health risks when inhaled, as a result of what the Agency for Toxic Substances and Disease Registry describes as the fluoride ion's "aggressive, destructive penetration of tissues."[13] Hydrogen fluoride irritates the nose, throat, and eyes, inflames the mucous membrane, causes coughing, and induces narrowing of the bronchial tubes. Acute exposures can cause the throat to swell and narrow, obstructing

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function development in children aged 10 to 18 years. *New England Journal of Medicine*.351:1057-1067.

[10] Agency for Toxic Substances and Disease Registry (ATSDR). 2010. *Medical Management Guidelines for Hydrogen Chloride (HCl)*. Updated September 1, 2010. Accessed February 27, 2011. http://www.atsdr.cdc.gov/MHMI/mmg173.pdf.

[11] U.S. Environmental Protection Agency (EPA). 2000. *Air Toxics Web Site: Hydrochloric Acid (Hydrogen Chloride) Hazards Summary*. Web Link: http://www.epa.gov/ttn/atw/hlthef/hydrochl.html [Accessed February 18, 2011].

[12] U.S. Environmental Protection Agency (EPA). 2000. *Air Toxics Web Site: Hydrogen Fluoride Hazards Summary*. Web Link: http://www.epa.gov/ttn/atw/hlthef/hydrogen.html [Accessed February 18, 2011].

breathing. The reaction to inhaled hydrogen fluoride may not appear for several hours to days after exposure. As with many chemicals, hydrogen fluoride does have benefits under the right circumstances, which are not present in this case: long-term oral exposure to lowlevels of fluoride prevents dental cavities and hardens the bones.[13]

At high levels of exposure, chlorine can lead to harmful health impacts. Inhalation of low concentrations can irritate the nose and throat and cause headache. Intermediate amounts of chlorine can cause immediate chest pain, nausea, vomiting, cough, and shortness of breath. Acute exposure to higher levels can lead to more severe health effects and be life threatening; inflammation of lung tissue, pulmonary edema, pneumonia, and even death may result (ATSDR, 2010c).[14] Exposure to high concentrations of chlorine has also been linked to long-term neurological effects, such as memory loss, slow reaction time, impaired balance, hearing loss, and visual alterations.[14]

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[13] Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological profile for Hydrogen Fluoride. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp11-c3.pdf [Accessed: 14 June 2011]. ("ATSDR 2003")

[14] Agency for Toxic Substances and Disease Registry (ATSDR). 2010. Toxicological profile for Chlorine. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp172-c3.pdf [Accessed: 14 July 2011]. ("ATSDR, 2010b")

b. Dioxins and Furans (Example: 2,3,7,8-Tetrachlorodibenzo-p-dioxin, Known as TCDD)

Dioxins and furans are a family of toxic chemicals that primarily arise from the burning of fossil fuels, such as coal, and exist in the atmosphere both as a gas and particles.[15] As particles, they can remain airborne for more than ten days, traveling far from their source, and depositing in water and soil.[16] Dioxins have even been found in the U.S. food supply; in 2002-2003, the U.S. Department of Agriculture found dioxin-like substances in meat and poultry.[17] Researchers have found dioxins in the breast milk of nursing mothers.[18]

Short-term exposures can cause liver damage and skin lesions, while longterm exposures can harm the immune system, the developing nervous system, the reproductive system, and disrupt hormone

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[15] Oh JE, Choi JS, Chang YS. 2001. Gas/particle partitioning of polychlorinated dibenzo-p-dioxins and dibenzofurans in atmosphere; evaluation of predicting models. *Atmospheric Environment* 35(24): 4125-4134.

[16] Atkinson, R. 1991. Atmospheric lifetimes of dibenzo-p-dioxins and dibenzofurans. *The Science of the Total Environment* 104 (1-2): 17-33.

[17] Hoffman MK, Huwe J, Deyrup CL, Lorentzsen M, Zaylskie R, Clinch NR, Saunders P, Sutton WR, USDA – ARS. 2006. Statistically Designed Survey of Polychlorinated Dibenzo-p-dioxins, Polychlorinated Dibenzofurans, and Co-Planar Polychlorinated Biphenyls in US Meat and Poultry, 2002-2003: Results, Trends, and Implications. *Environmental Science & Technology*. 40(17):5340-5346.

[18] Lorber M, Phillips L. 2002. Infant exposure to dioxin-like compounds in breast milk. *Environmental Health Perspectives* 100:A325-A332.

function. One form of dioxin—2,3,7,8-Tetrachlorodibenzo-p-dioxin, or TCDD—is recognized as a known human carcinogen.[19,20,21,22,23,24] Researchers are currently exploring the potential for dioxins to act as endocrine disrupters, by mimicking

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[19] National Toxicology Program. 2011. *Report on Carcinogens, Twelfth Edition*. Research Triangle Park, NC: U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program. 499 pp.

[20] World Health Organization (WHO). 2010. Fact Sheet: Dioxins and their effects on human health. Geneva, Switzerland: WHO. Web Link: http://www.who.int/mediacentre/factsheets/fs225/en/index.html [Accessed 3 February 2011]. ("WHO 2010")

[21] World Health Organization (WHO). 2011. *Concise International Chemical Assessment Documents*. Geneva, Switzerland: WHO: Web Link: http://www.who.int/ipcs/publications/cicad/en/. [Accessed 3 February 2011]. ("WHO 2011")

[22] Agency for Toxic Substances and Disease Registry (ATSDR). 1994. Toxicological profile for chlorodibenzofurans (CDFs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp32-c2.pdf [Accessed 14 Jun 2011].

[23] Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Toxicological profile for Chlorinated Dibenzo-p-dioxins (CDDs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp104-c2.pdf [Accessed: 14 June 2011].

[24] Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for Polychlorinated Biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp17-c3.pdf [Accessed: 14 June 2011].

natural hormones in the body and altering their normal function.[25] Last year, the World Health Organization concluded that developing fetuses and newborn children are most vulnerable to the harmful effects of dioxin and furan exposure.[20]

c. Radioisotopes (Examples: Radium, Uranium)

Radioisotopes, or certain forms of elements that are radioactive, emit ionizing radiation that can damage cells and contribute to cancer and other illnesses. Coal combustion is the leading source of radium released into the air, according to the ATSDR.[26] Radioisotopes are known carcinogens, especially as relates to the lungs, bones, and lymphatic system. They can also cause kidney disease, pneumonia, anemia, and brain abscess.[26, 3, 27,21]

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[25] Casals-Casas C, Desvergne B. 2011. Endocrine disruptors: from endocrine to metabolic disruption. *Annual Reviews of Physiology* 73:135-162.

[26] Agency for Toxic Substances and Disease Registry (ATSDR). 1990. Toxicological profile for radium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp144-c2.pdf [Accessed: 13 June 2011]. ("ATSDR, 1990")

[27] Agency for Toxic Substances and Disease Registry (ATSDR). 2011. Toxicological profile for Uranium (*Draft for Public Comment*). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. http://www.atsdr.cdc.gov/ToxProfiles/tp150-c3.pdf [Accessed: 13 June 2011].

d. Polynuclear Aromatic Hydrocarbons (PAH) (Examples: Naphthalene, Benzo-a-anthracene, Benzo-a-pyrene, Benzo-b-fluoranthene, Chrysene, Dibenzo-a-anthracene)

Polynuclear-Aromatic Hydrocarbons or PAHs are a group of over 100 chemicals formed during incomplete combustion of coal and other fuels; they include probable human carcinogens. PAHs adhere to particulate matter and deposit in the lungs.[28,3,29] New research warns that prenatal exposure to PAHs may impact the mental development of children to age 5.[28,30, 21]

e. Volatile Organic Compounds (Examples: Acetaldehyde, Benzene, Formaldehyde, Toluene, Xylene)

Volatile organic compounds take in a host of chemicals that include carcinogens and other toxins and also contribute to the formation of ozone.

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[28] Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for Polycyclic Aromatic Hydrocarbons (PAHs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp69-c2.pdf [Accessed: 14 June 2011].

[29] Vineis P and Husgfvel-Purisainen K. Air Pollution and cancer: biomarker studies in human populations. *Carcinogenesis* 2005; 26: 11: 1846-1855

[30] Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological profile for Naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp67-c3.pdf [Accessed: 13 June 2011].

According to EPA's Regulatory Impact Assessment, three organic hazardous air pollutants dominate the mass from coal-fired power plants: acetaldehyde, benzene, and formaldehyde. Benzene and formaldehyde are recognized as known human carcinogens, while acetaldehyde is considered a probable carcinogen.[31] Non-cancer effects associated with these organics include irritation of the skin, eyes, nose, and throat. These compounds can also cause difficulty in breathing, impaired lung function and respiratory symptoms, damage to the liver and kidneys, and stomach discomfort. They may also cause adverse effects to the nervous system, impaired memory, and slow response to visual stimuli.[32,33,34,35,36,3,21]

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[31] U.S. Department of Health and Human Services (HHS). National Toxicology Program. 2011. *Report on Carcinogens, Twelfth Edition*. Research Triangle Park, NC: U.S. Department of Health and Human Services.

[32] Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for Formaldehyde. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp111-c2.pdf [Accessed: 13 June 2011].

[33] Agency for Toxic Substances and Disease Registry (ATSDR). 2000a. Toxicological profile for Toluene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp56-c2.pdf [Accessed: 13 June 2011].

[34] Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological profile for Benzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp3-c3.pdf [Accessed: 13 June 2011].

f. Mercury (Including Methylmercury)

Mercury is a primary metal emitted from coal-fired power plant combustion in three forms: as a vaporous gas of elemental mercury; oxidized, and bound with particles. Elemental mercury stays airborne, resulting in widespread distribution. Oxidized and particle-bound mercury deposit nearer to the sources. Once released to the atmosphere, mercury returns to the earth in rain or snowfall, and pollutes waterways and the wildlife in them.[6] Microorganisms convert mercury into methylmercury, a highly toxic form of mercury that bioaccumulates in fish and shellfish.[37,38] Although a person can be exposed to mercury through breathing contaminated air or through skin contact, methylmercury is most easily absorbed by eating

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[35] Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological profile for Xylenes. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp71-c3.pdf [Accessed: 13 June 2011].

[36] Agency for Toxic Substances and Disease Registry (ATSDR). 2010. Toxicological profile for Ethylbenzene. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link:

http://www.atsdr.cdc.gov/ToxProfiles/tp110-c3.pdf [Accessed: 13 June 2011].

[37] Agency for Toxic Substances and Disease Registry (ATSDR). 1999. Toxicological profile for Mercury. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp46-c2.pdf [Accessed: 13 June 2011].

[38] Grandjean P. 2010. Adverse effects of methylmercury: environmental health research implications. *Environmental Health Perspectives* 118: 137-1145.

contaminated food, especially fish or shellfish. The long-term, low-level exposure to methylmercury that results from the regular consumption of contaminated fish is a primary health concern.[39]

Eating foods containing methylmercury can expose the brains of adults, children and developing fetus to harm. Critical periods are during pregnancy and in the early months after children are born.[37] Mercury exposure can lead to developmental birth defects and interfere with neurological development.[40] Pregnant women who consume fish and shellfish can transmit methylmercury to their developing fetus, and infants can ingest methylmercury in breast milk. Children can also become exposed by eating contaminated fish.[32] Each year, more than 300,000 children born in the US have levels of mercury in their blood high enough to impair performance on brain development test and permanently affect intelligence.[41,42] Additionally,

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[39] U.S. Environmental Protection Agency (EPA). 1997. *Mercury Study Report to Congress*, Volumes I – VIII: (EPA-452/R-97-003 through EPA-452/R-97-010). Washington, DC, USA: EPA.

[40] Bose-O'Reilly S, McCarty KM, Steckling N, Lettmeier B. 2010. Mercury Exposure and Children's Health. *Current Problems in Pediatric and Adolescent Health Care* 40(8):186-215.

[41] Trasande L, Landrigan PJ, Schechter C. 2005. Public health and economic consequences of methylmercury toxicity to the developing brain. *Environmental Health Perspectives* 113(5): 590-596.

[42] Axelrad DA, Bellinger DC, Ryan LM, Woodruff TJ. 2007. Dose-response relationship of prenatal mercury exposure and IQ: An integrative analysis of epidemiologic data. *Environmental Health Perspectives*. 115(4): 609-615.

mercury can damage the kidneys, liver, brain, and nervous system as a potent neurotoxin, even in adults.[37,3.21] A recent study has also found that methylmercury exposure may lessen the cardiovascular benefits of regular fish consumption.[43]

g. Non-Mercury Metals (Examples: Arsenic, beryllium, cadmium, chromium, lead, nickel, selenium, manganese)

Non-mercury metals and metal-like substances (e.g. arsenic and selenium) comprise a significant part of fine particulate matter (PM2.5) directly emitted from coal-fired power plants. Fine particle pollution is aggravated by the secondary particles formed as a result of chemical reactions in sulfur dioxide and nitrogen oxides emissions. Those secondary particles, notably sulfates and nitrates, pose lifethreatening risks similar to those from primary particle emissions.

Inhaled particles deposit along the respiratory tract or penetrate deeply into the gas-exchange region of the lung. EPA has already concluded that exposure to fine particulate matter (PM2.5) causes cardiovascular effects and premature mortality and is likely to cause respiratory harm. The Agency concluded that the evidence suggests that long-term exposure to PM2.5 causes reproductive and developmental effects as well as cancer, mutagenicity and genotoxicity.[4] The risks of cardiovascular harm include acute myocardial infarction, congestive heart

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[43] Domingo JL. 2007. Omega-3 fatty acids and the benefits of fish consumption: is all that glitters gold? *Environment International*. 33(7):993-8.

failure, cardiac arrhythmias, and strokes. Risks of respiratory harm include coughing, wheezing, difficulty breathing, asthma exacerbations, and increased hospitalization for chronic obstructive pulmonary disease (COPD).[4] Evidence has also grown to warn that long-term exposure to PM 2.5 can increase the risk of low birth weight, infant mortality, and cancer, especially lung cancer.[4]

The level of toxicity of fine particles varies and is likely impacted by the presence of metals or other pollutants.[44] Metals interact with particles to create "reactive oxygen species" which limit the body's ability to repair damage to its cells and contribute to tissue inflammation.[45,46,47] Research has shown that sulfate, selenium, iron, nitrate, and organic carbon affect immune cell response and heart variability.[48,49]

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[44] Bell ML, Dominici F, Ebisu K, Zeger SL, Samet JM. 2007. Spatial and temporal variation in PM2.5 chemical composition in the United States for health effects studies. *Environmental Health Perspectives* 115(7):989-995.

[45] Carter JD, Ghio AJ, Samet JM, Devlin RB. 1997. Cytokine Production by Human Airway Epithelial Cells after Exposure to an Air Pollution Particle Is Metal- Dependent. *Toxicology and Applied Pharmacology*. 146(2):180-188.

[46] Gurgueira SA, Lawrence J, Coull B, Krishna Murthy GG, Gonzalez-Flecha B. 2002. Rapid increases in the steady-state concentration of reactive oxygen species in the lungs and heart after particulate air pollution inhalation. *Environmental Health Perspectives* 110(8): 749-765.

[47] Wilson MR, Lightbody JH, Donaldson K, Sles J, Stone V. 2002. Interactions between Ultrafine Particles and Transition Metals *in Vivo and in Vitro*. *Toxicology and Applied Pharmacology* 184(3): 172-179.

[48] Huang, Y.-CT, Ghio AJ, Stonehuerner J, McGee J, Carter JD, Grambow SC, and Devlin RB. 2003. The role of soluble

Elevated presence of chromium, lead, and other metals in PM has been associated with greater effects on hospital admissions for cardiovascular disease, according to a study of Medicare recipients in 26 communities.[50] Zanobetti et al. found that admissions for heart attacks were higher where the PM was enriched in arsenic, chromium, manganese, nickel, and organic carbon. The same study found that showing up in high levels of arsenic, organic carbon, and sulfate in PM—potential indicators of coal combustion—were associated with increased hospital admissions for diabetics.[50] A large study of 25 U.S. communities found increased mortality rates when the fraction of aluminum, sulfate, and nickel in particulate matter was highest.[51] This study found additional evidence warning that the combination of metals in particles, a common occurrence, may increase their toxicity.

Arsenic exposure can occur through the dermal, oral, and inhalation routes. As a known carcinogen,

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components in ambient fine particles-induced changes in human lungs and blood. *Inhalation Toxicology*. 15:327-342.

[49] Chuang KJ, Chan CC, Su TC, Lin LY, Lee CT. 2007. Associations between particulate sulfate and organic carbon exposures and heart rate variability in patients with or at risk for cardiovascular diseases. *Journal of Occupational and Environmental Medicine* 49(6):610-617.

[50] Zanobetti A, Franklin M, Koutrakis P, Schwartz J. 2009. Fine particulate air pollution and its components in association with cause-specific emergency admissions. *Environmental Health* 8:58.

[51] Franklin M, Koutrakis P, Schwartz J. 2008. The Role of Particle Composition on the Association Between PM2.5 and Mortality. *Epidemiology*. 19: 680-698.

inhalation of arsenic has been strongly associated with lung cancer.[31] Short-term inhalation can harm the gastrointestinal tract, cause nausea and diarrhea, and even adversely affect the nervous system. Long-term inhalation has been associated with irritation of the skin and mucous membranes. Exposure can lead to respiratory tract irritation, conjunctivitis, and damage nasal tissue.[52] Similar to effects of inhaling arsenic, arsenic in drinking water has also been linked to skin, bladder, lung, and liver cancer.[31] Long-term exposure through ingestion can result in anemia, lesions, liver, kidney, and nerve damage, and affect the digestive system.[53]

Beryllium is a known carcinogenic metal.[31] Inhaled beryllium has been found to increase the risk of lung cancer.[54,55] Breathing large amounts of beryllium compounds can damage the lungs and cause the lungs to resemble pneumonia with reddening and swelling. Long-term exposure may

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[52] Agency for Toxic Substances and Disease Registry (ATSDR). 1998. Medical Management Guidelines for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services. Web link: http://www.atsdr.cdc.gov/mhmi/mmg168.html#bookmark02. [Accessed June 16, 2011].

[53] Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological profile for Arsenic. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp2-c3.pdf [Accessed: 13 June 2011].

[54] Steenland K, Ward E. 1991. Lung cancer incidence among patients with beryllium disease: a cohort mortality study. *J Natl Cancer Inst* 83(19): 1380-1385.

[55] Ward E, Okun A, Ruder A, Fingerhut M, Steenland K. 1992. A mortality study of workers at seven beryllium processing plants. *Am J Ind Med* 22(6): 885-904.

cause chronic beryllium disease. People with chronic beryllium disease may experience weakness, fatigue, difficulty breathing, anorexia, weight loss, and blueness of the hands and feet. The disease can lead to heart enlargement, heart disease, and even death.[56]

Cadmium is another known carcinogenic metal.[31] Exposure to airborne cadmium causes lung cancer, as the International Agency for Research on Cancer reaffirmed in 2009.[57] Prolonged inhalation of cadmium can also lead to gradual accumulation of the metal in the kidneys, resulting in kidney disease.[58]

Chromium occurs in three main forms, one of which, chromium (IV), is a known carcinogen that can increase the risk of lung cancer.[59,31] The metal

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[56] Agency for Toxic Substances and Disease Registry (ATSDR). 2002. Toxicological profile for Beryllium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp4-c3.pdf [Accessed: 13 June 2011].

[57] Straif K, Benbrahim-Tallaa L, Baan R, Grosse Y, Secretan B, El Ghissassi F, et al. 2009. A review of human carcinogens—Part C: metals, arsenic, dusts, and fibres. *Lancet Oncol* 10(5):453-454.

[58] Agency for Toxic Substances and Disease Registry (ATSDR). 2008. Toxicological profile for Cadmium (*Draft for Public Comment*). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp5-c3.pdf [Accessed: 13 June 2011].

[59] Agency for Toxic Substances and Disease Registry (ATSDR). 2008. Toxicological profile for Chromium (*Draft for Public Comment*). Atlanta, GA: U.S. Department of Health and

primarily affects the respiratory system, although chromium (VI) can also impact the gastrointestinal, immunological, hematological, reproductive and developmental systems, particularly if ingested. Inhaling chromium (VI) can cause coughing and wheezing, shortness of breath, bronchitis, pneumonia, decreased lung function, and other respiratory conditions. In workers, inhaled chromium (VI) has been linked develop asthma development and asthma attacks.[59]

The most common health effects associated with lead exposure impact the nervous system and damage its functions. Lead may also cause joint weakness, anemia, and increased blood pressure.[60] Although lead is harmful to both adults and children, children are most susceptible to its effects. Lead can cause developmental disorders whose effects can persist beyond childhood.[61] Exposure can affect a child's physical and mental growth, resulting in slower mental development and lower levels of intelligence. Lead is also a probable carcinogen.[31]

Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp7-c3.pdf [Accessed: 13 June 2011].

[60] Agency for Toxic Substances and Disease Registry (ATSDR). 2007. Toxicological profile for Lead. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp13-c3.pdf [Accessed: 14 June 2011].

[61] Agency for Toxic Substances and Disease Registry (ATSDR). 2007e. Public Health Statement for Lead. CAS#: 7439-92-1. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/phs13.html [Accessed: 16 June 2011].

Similar to lead, manganese mostly affects the nervous system. For example, adverse effects to hand-eye coordination, hand steadiness, and visual reaction time were observed in humans exposed to manganese.[62] High exposure levels may result in feelings of lethargy and weakness, psychological impacts, and tremors.

Compounds containing nickel have been determined to be carcinogenic.[31] A known health effect of nickel exposure is the increased risk of lung and nasal cancers from nickel dust.[63]

Selenium exposure can result in adversely affect the respiratory system by irritating mucous membranes and causing pneumonia, bronchitis, and pulmonary edema.[64] One selenium compound, selenium sulfide, is also considered to be a probable human carcinogen.[31]

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[62] Agency for Toxic Substances and Disease Registry (ATSDR). 2008c. Toxicological profile for Manganese (*Draft for Public Comment*). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp151-c3.pdf [Accessed: 13 June 2011].

[63] Agency for Toxic Substances and Disease Registry (ATSDR). 2005. Toxicological profile for Nickel. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp15-c3.pdf [Accessed: 13 June 2011].

[64] Agency for Toxic Substances and Disease Registry (ATSDR). 2003. Toxicological profile for Selenium. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service. Web link: http://www.atsdr.cdc.gov/ToxProfiles/tp92-c3.pdf [Accessed: 13 June 2011].

h. Secondary Particles

Meeting the limits for toxic air emissions set under the Mercury and Air Toxics standard provides a crucial collateral benefit: reduction in secondary PM 2.5, especially sulfates and nitrates. Reductions to sulfur dioxide and nitrogen oxide emissions are anticipated to occur as a result of the actions undertaken to meet the requirements of this rule. The reductions will also decrease secondary particle formation. Measures that reduce acid gases will reduce sulfur dioxide and consequently, reduce the burden of sulfate particles across the nation. EPA projects that combined pollution control technologies to meet the limits on mercury will also reduce oxides of nitrogen. In addition, fuel switching and retirements are also expected to reduce nitrogen oxide emissions, and consequently nitrate particles. Sulfates formed from sulfur dioxide comprise the majority of fine particulate matter in much of the United States, especially during the summer months. Nitrogen oxides form nitrates, the third largest source of PM 2.5.[65] As discussed earlier, there is evidence showing that PM 2.5 causes cardiovascular harm and premature mortality, and is likely associated with respiratory disease. Additional studies suggest that long-term exposure to PM2.5 may lead to reproductive and developmental effects, as well as cancer, mutagenicity, and genotoxicity.[4]

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[65] U.S. Environmental Protection Agency (EPA). 2011. Regulatory Impact Analysis for proposed Air Toxics Rule, Office of Air Quality Planning and Standards, Research Triangle Park, NC. Web link: http://www.epa.gov/ttn/ecas/regdata/RIAs/ToxicsRuleRIA.pdf [Accessed 16 June 2011].

2. Millions of People Face Higher Risk

Many individuals face greater risk because of their age, health conditions, or rate of exposure to the pollutants. Individuals at greater risk include: infants, children and teenagers; seniors; pregnant women; individuals with asthma and other lung diseases; people with cardiovascular diseases; diabetics; low-income communities; and those who work or exercise outdoors.[4,39] The discussion below highlights special concerns for several of these groups.

Children are more vulnerable to the adverse health effects of acid gases (and to all air pollution) than adults. Children grow 80 percent of their lungs between birth and adolescence. During the early postnatal period these delicate, growing tissues are at greatest risk. Children also breathe more rapidly and tend to spend more time outdoors than adults, leading to higher pollutant exposures.[66]

Even before birth children confront increased risk. As noted earlier, fetuses, infants, and children face impaired neurological development and cognitive abilities, memory, language skills because of the toxic effects of methylmercury exposure. Dioxins and furans threaten their developing systems, including the nervous system, and these toxics and others may increase the risk of cancer in children. Furthermore, estimates for children may

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[66] American Academy of Pediatrics, Committee on Environmental Health. 2004. Ambient Air Pollution: Health Hazards to Children. *Pediatrics*; 114: 1699-1707. Reaffirmed in 2010.

understate the risks from toxics because of limited monitoring, incomplete information on toxicity and use of models that do not consider the potential for increased risk in children.[66]

People with chronic diseases, including cardiovascular diseases, respiratory diseases and diabetes, face higher risk regardless of age. Current estimates of this group include:

- Asthma 24.6 million people, including 7.0 million under age 18.[67]

- Cardiovascular diseases – 82.6 million people.[68]

- Diabetes – 25.8 million people.[69]

- Chronic Obstructive Pulmonary Disease (COPD)—12.1 million adults age 18 and older.[70]

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[67] American Lung Association. 2011. Trends in Asthma Morbidity and Mortality. Weblink: http://www.lungusa.org/finding-cures/our-research/trend-reports/asthmatrend-report.pdf.

[68] Roger VL, Go AS, Lloyd-Jones DM, et al. 2011. Heart disease and stroke statistics: 2011 update: a report from the American Heart Association. *Circulation*. 123(4):e18–e209

[69] Centers for Disease Control and Prevention. (CDC) 2011. National Diabetes Fact Sheet: National Estimates and General Information on Diabetes and Prediabetes in the United States, 2011. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

[70] American Lung Association. 2010. Trends in COPD (Chronic Bronchitis and Emphysema): Morbidity and Mortality. Weblink: http://www.lungusa.org/findingcures/ our-research/trend-reports/copd-trend-report.pdf.

As adults age, physiological process naturally decline. This places even healthy individuals advanced in age at risk from airborne pollutants. In addition, many adults also have one or more chronic diseases, increasing their susceptibility to the effects of toxic air emissions.[4]

Individuals with low incomes or that are members of racial and ethnic minorities bear a disproportionate burden of the health effects of air pollution. Since they are more likely to live close to industrial facilities and high traffic areas, low-income and minority populations are at much higher risk of exposure to the most harmful pollutants.[71,72] One study found that 68 percent of African Americans lived within 30 miles of a coal-fired power plant.[73] Another study of five power plants in the Washington, DC area found that African Americans and individuals without a high school education were among the groups hardest hit by pollution from the plants. Almost half of the risks for premature death due to power plant pollution-related exposures were

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[71] Levy JI, Greco SL, Spengler JD. 2002. The importance of population susceptibility for air pollution risk assessment: a case study of power plants near Washington, DC. Environmental Health Perspectives. 110(12):1253-60.

[72] O'Neill MS, Jerrett M, Kawachi I, Levy JI, Cohen AJ, Gouveia N, et al. 2003. Health, Wealth, and Air Pollution: Advancing Theory and Methods. *Environmental Health Perspectives* 111:1861-1870.

[73] Georgia Coalition for the Peoples' Agenda, Black Leadership Forum, the Southern Organizing Committee for Economic and Social Justice and Clear the Air. 2002. *Air of Injustice*. Access at http://www.catf.us/resources/publications/files/Air_of_Injustice.pdf.

borne by the 25 percent of the population without a high school education.[71]

B. The HAPs Emitted by EGUs are Associated with Adverse Environmental Effects

We strongly support EPA's assessment that Mercury and the other Hazardous Air Pollutants covered by this proposed regulation have adverse impacts on wildlife, including endangered species, and ecosystem health. The body of scientific evidence referenced in the proposed rule clearly supports the Agency's assessment, however it is important to note that there is more to the story. We offer a set of additional studies that demonstrate how much more serious, and widespread, the mercury contamination problem is in the U.S. Additionally, we provide brief mention of environmental impacts from some of the additional hazardous air pollutants covered by the proposed rule. New research presented here is intended to build on the scientific information accurately presented by EPA in this proposed rulemaking.

1. Mercury

Mercury is a highly toxic heavy metal that affects the function and development of the central nervous system in wildlife, resulting in a broad range of adverse impacts such as reproductive problems, behavioral abnormalities, and compromised immune systems.[74,75,76,77] Historically,

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[74] Tan, S.W, J.C. Miller, and K.R. Mahaffey. 2009. "The endocrine effects of mercury in humans and wildlife." *Critical Reviews in Toxicology* 39(3):228-269.

scientists have focused on fish eating wildlife as those most at risk of exposure to mercury. However, over the last few years has been a growing awareness among the scientific community that mercury is accumulating in far more habitats, and therefore far more species, than previously thought.[78,79,80] Scientists are also gaining a greater understanding about the impacts of high levels of mercury accumulation on the health of specific species. It has become clearer in recent years that significant exposure to mercury can actually lead to wildlife population declines.

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[75] Hawley, D.M., K.K. Hallinger, D.A. Cristol. 2009. "Compromised immune competence in free-living tree swallows exposed to mercury." *Ecotoxicology* (2009) 18:499-503

[76] Hallinger, K.K., D.A. Cristol. 2011. "The role of weather in mediating the effect of mercury exposure on reproductivie success in tree swallows." *Ecotoxicology*. Published online 5/8/11.

[77] Scheuhammer, A. M., M. W. Meyer, M.B. Sandheinrich, M.W. Murray. 2007. "Effects of Environmental Methylmercury on the Health of Wild Birds, Mammals, and Fish." *Ambio* Vol. 36, No. 1. p. 12

[78] Evers. David C. 2005. *Mercury Connections: The extent and effects of mercury pollution in northeastern North America.* BioDiversity Research Institute. Gorham, Maine. Online at : http://www.briloon.org/old_site/about/staff/documents/BRIMercury.pdf

[79] Wada, H., D. Yates, D. Evers, R. Taylor, W. Hopkins. 2010. "Tissue mercury concentrations and adrenocotical responses of female big brown bats near a contaminated river." *Ecotoxicology* 19: 1277-1284.

[80] Sleeman, J.M., D.A. Cristol, A.E. White, D.C. Evers, R.W. Gerhold. 2010. "Mercury Poisoning in a Free-Living Northern River Otter." *Journal of Wildlife Diseases* 46(3) 1035-1039.

In National Wildlife Federation's September, 2006 report *Poisoning Wildlife*, the full range of species at risk from mercury contamination was highlighted.[81] The report covered scientific data finding elevated levels of mercury in fish, aquatic birds, forest birds, mammals, reptiles, amphibians, and invertebrates, demonstrating that there is literally no corner of the food web untouched by mercury. Recent studies continue to show high levels of mercury accumulation in our environment. For example, a 2007 study that looked at mercury levels in four turtle species from a Virginia river found the highest levels of mercury ever recorded in reptiles.[82]

New studies connecting high levels of mercury with adverse impacts on wildlife populations are perhaps of greatest concern. It is clear that mercury levels in the environment have increased to levels posing risks to ecological and human health.

In a recent study of the Common loon in Maine and New Hampshire, adverse impacts on behavior, physiology, reproductive success, and survival were associated with high mercury levels. Specifically, higher levels of mercury lead to reduced number of chicks fledged per year. The study attributed high mercury levels as the driving stressor for declines in

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[81] National Wildlife Federation. 2006. *Poisoning Wildlife: The Reality of Mercury Pollution*. Online at: www.nwf.org/mercury

[82] Bergeron, Christine M. et al. 2007. "Influence of Feeding Ecology on Blood Mercury Concentrations in Four Species of Turtles." *Environmental Toxicology and Chemistry*, Vol. 26. No. 8. p. 1733-1741.

local breeding populations of loons in these areas.[83] Similar impacts were seen in a study of Avocet & Black-necked Stilt, where higher mercury levels were documented in dead chicks than in randomly selected live chicks of similar age.[84]

A recent study of American Kestrals also found that mercury bioavailability could have population level impacts. The research found that high levels of mercury lead to marked decrease in egg production, incubation performance, number of eggs hatched, and number successful fledglings. In cases where mercury levels were highest, total fledgling failure was observed.[85]

Mercury contamination has also recently been linked to population declines for songbirds and species that forage in wetlands.[86] New research has lead to greater understanding of mercury level thresholds where impacts on nesting success can be predicted. Specifically, species including the Traill's Flycatcher, Yellow-throated Vireo, Seaside Sparrow,

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[83] Evers, David C. et al. 2008. "Adverse Effects from Environmental mercury loads on breeding common loons." *Ecotoxicology* 17:69-81.

[84] Ackerman, J.T., J.Y. Takekawa, C.A. Eagles-Smith. S.A. Iverson. 2008. "Mercury contamination and effects on survival of American avocet and black-necked stilt chicks in San Francisco Bay. *Ecotoxicology* (2008) 17:103-116.

[85] Albers, Peter H. et al. 2007. "Effects of Methylmercury on Reproduction in American Kestrals." *Environmental Toxicology and Chemistry* Vol 26, No. 9, p.1856-1866.

[86] Edmonds, Samuel T. et al. 2010. "Geographic and Seasonal Variation in Mercury Exposure of the Declining Rusty Blackbird." *The Condor* 112(4): 789-799.

Red-winged Blackbird, Eastern Wood Pewee, Yellow Palm Warbler, Indigo Bunting, and Nelson's Sparrow have all been found with mercury levels above this threshold, indicating they are at risk of reduced nesting success.[87] Additionally, species including Carolina Wren, House Wren, and Song Sparrow in mercury-contaminated habitats have been found to have a lower diversity of song note types and lower tonal frequencies than those in areas with lower mercury levels.[88] This kind of behavioral abnormality can adversely affect bird's ability to perform functions critical to survival and reproduction.

In addition to birds, a recent study found adverse effects of elevated mercury levels in Salamanders. Specifically, high levels of mercury were linked to reduced speed and responsiveness, and as well as inability to successfully execute tasks critical for survival such as hunting.[89]

2. Acid Gases

We strongly support the proposed regulation's reduction of acid gas emissions, given the

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[87] Evers et al. 2011 (DRAFT). Hidden Risk – Mercury in Terrestrial Ecosystems. BioDiversity Research Institute Gorham, Maine. p.11. Draft report, due to be released August 2011. Online at: www.briloon.org

[88] Hallinger, K.K. 2010. "Birdsong Differs Between Mercury-Polluted and Reference Sites" *The Auk* 127(1):156-161.

[89] Burke, J.N., C.M. Bergeron, B.D. Todd, W.A. Hopkins. 2010. "Effects of mercury on behavior and performance of northern two-lined salamanders. *Environmental Pollution* 158(2010):3546-3551

devastating impact that acid rain has on our forests, lakes, and streams.[90] Acidified ecosystems leach calcium and magnesium from soil, which reduces the availability of invertebrates, a critical prey source for many species, and adversely impacts birds breeding success.[91] Acidification has also been linked to fish[92] and bird[93] species declines, and a range of impacts on other wildlife.[94]

It is also important to note that acidified ecosystems also exacerbate mercury contamination problems. Studies have shown that highly acidic environments facilitate greater methylation of

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[90] Driscoll, Charles T et al. 2001. *Acid Rain Revisited*. Hubbard Brook Research Foundation. Science Links Publication. Vol. 1 No. 1. Online at: http://www.hubbardbrook.org/6-12_education/Glossary/AcidRain.pdf

[91] Likens, G.E., C.T. Driscoll, and D.C.Buso. 1996. "Long term effects of acid rain: response and recovery of a forest ecosystem." *Science* 272:2444-246.

[92] Dana R. Warren, Gene E. Likens, Donald C. Buso and Clifford E. Kraft. "Status and Distribution of Fish in an Acid-Impacted Watershed of the Northeastern United States (Hubbard Brook, NH)." *Northeastern Naturalist* Vol. 15, No. 3 (2008), p. 375- 390.

[93] Ralph S. Hames, Kenneth V. Rosenberg, James D. Lowe, Sara E. Barker and André A. Dhondt. "Adverse Effects of Acid Rain on the Distribution of the Wood Thrush Hylocichla mustelina in North America." *Proceedings of the National Academy of Sciences of the United States of America*. Vol. 99, No. 17 (Aug. 20, 2002), p. 11235-11240.

[94] R. Kent Schreiber and James R. Newman. "Acid Precipitation Effects on Forest Habitats: Implications for Wildlife." *Conservation Biology* Vol. 2, No. 3 (Sep., 1988), pp. 249-259.

mercury, which leads to more significant uptake into the food web.[95,96,97]

3. Other Hazardous Air Pollutants

This proposed regulation seeks to reduce a large range of toxic emissions, many of which we know have devastating impacts on wildlife health. A recent publication from the Society of Environmental Toxicology and Chemistry (SETAC)[98] provides a comprehensive look at the impacts of toxic exposure to a variety of wildlife.[99] A selection of key findings from this research and others are summarized in this subsection.

Arsenic has long been recognized for its toxic properties. Studies have linked arsenic exposure,

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[95] Driscoll, Charles T., et al. 2007. "Mercury Contamination in Forest and Freshwater Ecosystems in the Northeastern United States." *Bioscience* Vol. 57 No. 1. p. 17.

[96] Gilmour, Cynthia. "The Effect of the Sulfur Cycle on Methylmercury Production." *2003 Everglades Consolidated Report*. Appendix 2B-2: Status Report on the Effect of Water Quantity and Quality on Methylmercury Production. A-2B-2-1. Online at: http://www.dep.state.fl.us/water/wqssp/everglades/consol_rpt.htm

[97] Cristol, Daniel A. et al. 2008. "The Movement of Aquatic Mercury Through Terrestrial Food Webs." *Science* Vol. 320. p. 335

[98] http://www.setac.org/node/1

[99] W. Nelson Beyer, James P. Meador, eds. *Environmental Contaminants in Biota: Interpreting Tissue Concentrations*. 2011. CRC Press, Boca Raton, FL. Online at: http://www.amazon.com/Environmental-Contaminants-Biota-Interpreting-Concentrations/dp/1420084054/ref=sr_1_1?ie=UTF8&qid=1312391692&sr=8-1

even at very low doses, with severely adverse impacts on cell growth.[100] At higher doses, arsenic exposure can lead to cancer and death.[101] Arsenic in soils has also been linked reduced root growth[102] and loss of vegetative cover, which was also accompanied by a reduction in capacity to support indigenous wildlife populations.[103]

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[100] Fritzie T. Celino, Sonoko Yamaguchi, Chiemi Miura, Takeshi Miura. "Arsenic inhibits *in vitro* spermatogenesis and induces germ cell apoptosis in Japanese eel (*Anguilla japonica*)." *Reproduction* August 1, 2009. 138 279-287. Online at: www.reproduction-online.org/content/138/2/279.abstract?relatedurls=yes&legid=reprod;138/2/279

[101] Gomez-Caminero, P. Howe, M. Hughes, E. Kenyon, D.R. Lewis, M. Moore, J. Ng, and by A. Aitio and G. Becking. "Environmental Health Criteria 224: Arsenic and Arsenic Compounds." Published under the joint sponsorship of the United Nations Environment Programme, the International Labour Organization, and the World Health Organization, and produced within the framework of the Inter-Organization Programme for the Sound Management of Chemicals, 2001. Online at: http://whqlibdoc.who.int/ehc/WHO_EHC_224.pdf

[102] Kapustka, L. A., Lipton, J., Galbraith, H., Cacela, D. and Lejeune, K. 1995. "Metal and arsenic impacts to soils, vegetation communities and wildlife habitat in southwest montana uplands contaminated by smelter emissions: II. Laboratory phytotoxicity studies." *Environmental Toxicology and Chemistry* 14: 1905–1912. Online at: http://onlinelibrary.wiley.com/doi/10.1002/etc.5620141112/abstract

[103] Galbraith. H.; LeJeune, K.; Lipton, J. "Metal and arsenic impacts to soils, vegetation communities and wildlife habitat in southwest Montana uplands contaminated by smelter emissions: I Field evaluation." Environmental Toxicology and Chemistry, 14, 1895-1903. 1995. Online at: http://onlinelibrary.wiley.com/doi/10.1002/etc.5620141111/abstract

Dioxin is a highly toxic compound that is linked to cancer and adverse reproductive impacts in humans. Scientists have also found that high levels of dioxin in fish (rainbow trout and minnows) have severe effects, including reduced reproductive success, slower growth rates, abnormal physiology, lesions, and mortality.[104]

Studies have found that small mammals with high levels of cadmium had adverse health effects that affect survival and fitness, and also experienced kidney damage.[105]

High levels of lead in mammals and birds have been linked to neurotoxic effects, reproductive problems, nephrotoxic and hematological changes, loss of body weight, kidney and brain damage, and death.[106,107]

High levels of selenium have been found to have extremely toxic effects on wildlife. Specifically, studies of birds with high selenium have found reduced egg hatchability, deformities in

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[104] Beyer & Meador. 2011. Chapter 3. "Dioxins, PCBs, and PBDEs in Aquatic Organisms." Richard J. Wenning, Linda Martello, and Anne Prusak-Daniel. p. 103 – 168.

[105] Beyer & Meador, 2011. Chapter 19. "Cadmium in Small Mammals." John. A. Cooke. p. 627-644.

[106] Beyer & Meador, 2011. Chapter 17. "Lead in Mammals." Wei-Chun Ma. p. 595- 608.

[107] Beyer & Meador, 2011. Chapter 16. "Lead in Birds." J. Christian Franson and Deborah J. Pain. p. 563-594.

embryos/chicks, and other reproductive problems.[108,109]

Similar studies of fish linked high levels of selenium with reproductive failure and mortality.[110]

4. Reducing Mercury Emissions Will Benefit Local Environments

Recent research has confirmed that local sources of mercury emissions contribute the most to local contamination problems. In fact, a 2007 study confirmed the presence of mercury "hot spots" downwind from coal-fired power plants.[111] It is clear reducing mercury emissions from these stacks will greatly benefit downwind waters.

The 2007 hotspot study builds on previous studies confirming that coal-fired power plants within the United States are the primary source of mercury to the Great Lakes and the Chesapeake

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[108] Beyer & Meador, 2011. Chapter 21, "Selenium in Birds" Harry M. Ohlendorf and Gary H. Heinz. 669-702

[109] Fred L. Paveglio, Christine M. Bunck and Gary H. Heinz. "Selenium and Boron in Aquatic Birds from Central California." *The Journal of Wildlife Management* Vol. 56, No. 1 (Jan., 1992), pp. 31-42 Online at: http://www.jstor.org/pss/3808788

[110] Beyer & Meador, 2011. Chapter 5. "Selenium Accumulation and Toxicity in Freshwater Fishes." David K. DeForest and William J. Adams. P. 193-230.

[111] Evers, David C. et al. 2007. Biological Mercury Hotspots in the Northeastern United States and Southeastern Canada, Bioscience. Vol. 57 No. 1. p. 29

Bay.[112,113] It is also consistent with a major mercury deposition study conducted by EPA and the University of Michigan that concluded that approximately 70 percent of mercury wet deposition resulted from local fossil fuel emissions in the region.[114]

5. Economic Benefits of Reducing Environmental Effects of Air Toxics

Numerous studies have indicated that substantial economic benefits would be achieved by reducing environmental exposure to mercury and other HAP. Some of the findings from these studies are listed below:

- The Environmental Protection Agency underestimated by $10.5 billion the annual net benefits of a proposal to set standards for mercury and other air toxics from power plants, according to a Navigant Consulting Inc. report released July 14, 2011.[115] In total, the annual net

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[112] M. Cohen, et al., *Modeling the Atmospheric Transport and Deposition of Mercury to the Great Lakes*, Environmental Research 95, 2004 (247-265).

[113] Mark Cohen, NOAA, *Modeling the Fate and Transport of Atmospheric Mercury in the Chesapeake Bay Region* (May 17, 2004), slide 34. Online at: http://www.arl.noaa.gov/data/web/reports/cohen/20_Ches_Bay_talk.pdf (visited November 20, 2006).

[114] Keeler, G., et al. 2006. "Sources of Mercury Wet Deposition in Eastern Ohio, USA," *Environmental Science & Technology*.

[115] *Why EPA's Mercury and Air Toxics Rule is Good for the Economy and America's Workforce*, is available at http://www.cleanair.org/sites/default/files/MercuryRuleEconomicsReport.pdf.

benefits of the rule would be $52.5 billion to $139.5 billion, said the report, which was sponsored by the Clean Air Council and other organizations.

- The Minnesota Pollution Control Agency and the Legislative Commission on Minnesota Resources estimate the economic benefits of reduced mercury pollution at $212 million. This is based on a 50 percent reduction in regional Midwest emissions, which is projected to reduce mercury deposition in Minnesota by approximately 12 percent.[116] This study clearly understates the total economic benefits of reduced mercury pollution, because it takes into account only Minnesota residents' willingness to pay, and not economic benefits due to factors such as improved public health.

- Researchers from the Harvard School of Public Health estimate the healthrelated economic impact of mercury pollution at over $5.5 billion. The study estimates the costs of lost productivity due to reduced IQs resulting from mercury pollution at $1.625 billion, the costs of excess mental retardation cases from mercury emissions at approximately $361 million, and the costs of

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[116] Daniel A. Hagen, et al, *Economic Benefits of Reducing Mercury Deposition in Minnesota* (June 1999), Minnesota Pollution Control Agency report, available at http://www.pca.state.mn.us/index.php/component/option,com_docman/task,doc_view/gid,313.

excess cardiovascular disease from mercury emissions at approximately $3.54 billion.[117]

- In Minnesota, a long-term decline in angling of just 25 percent due to the lake- and stream-fouling effects of mercury could cost the state's economy $706 million per year and jeopardize a portion of the estimated 25,955 jobs in Minnesota that depend on fishing.[118]

- In Wisconsin, a long-term decline in angling of just 25 percent due to the lake- and stream-fouling effects of mercury could cost the state's economy $516 million per year and jeopardize a portion of the estimated 21,459 jobs in Wisconsin that depend on fishing.[119]

Based on these and other similar studies, we urge you to recognize that the pollution emitted by EGUs results in a cost that is being unfairly borne by others. Reducing and in some cases eliminating pollution is therefore an appropriate and necessary shift of the cost back to where it belongs—on the polluting source and unit itself. In addition, the cost-

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[117] Paul R. Epstein, et al, *Full cost accounting for the life cycle of coal*, ANNALS OF THE NEW YORK ACADEMY OF SCIENCES, 1219:73-98 (2011), available at http://onlinelibrary.wiley.com/doi/10.1111/j.1749-6632.2010.05890.x/full.

[118] Minnesota Environmental Partnership, Mercury Pollution Threatens Minnesota's Fishing Industry, Press Release, Aug. 17, 2004, available at http://www.mepartnership.org/mep_newsroom.asp?new_id=787.

[119] Clean Wisconsin, 25% Drop in Wisconsin Fishing Due to Mercury Would Cost $516M Annually, Press Release, Aug. 16, 2004, available at http://www.cleanwisconsin.com/index.php?module=cms&page=323.

benefit analysis provided by EPA is welcome but insufficient. It includes an important focus on human health but fails to include sufficient assessment and valuation of impacts on wildlife and ecosystems. Not only is it the duty of EPA to prepare such estimates for alternative sources as part of the Biological Assessment EPA must bring to its consultation with the wildlife agencies under the ESA, but the Clean Air Act also requires EPA in general to address the needs of wildlife and ecosystems, in setting secondary standards, for example. Costs and benefits of pollution reductions for wildlife are harder to assess since more research is needed on levels of pollutants in many wildlife species and in assessing the full range of the pollutants' impacts on ecosystems. But there has also been much progress in such research, and in recognition of the economic role that ecosystems play. We therefore urge that in this instance, and indeed in all instances where cost-benefit analyses of rules and regulations are involved, such analysis be broadened to include valuation of impacts on wildlife and ecosystems, however incomplete it may be.

6. Duty to Formally Consult with the Fish and Wildlife Service and the National Marine Fisheries Service (NMFS) Regarding Impacts on Endangered and Threatened Species, and the Level at Which Standards Must Be Set to Protect Them

Since endangered, threatened and other protected species such as the Indiana bat, Florida panther, bald eagle, and polar bear have been documented with high levels of mercury, and since

the livelihood and reproductive success of these creatures can be affected by this and other hazardous pollutants, EPA is required to consult with the appropriate agencies (FWS and NMFS) to determine the levels at which emissions need to be set not only to ensure that the levels allowed by EPA will not be likely to jeopardize the continued existence and recovery in the wild of these species, as required under Section 7(a)(2) but also to meet EPA's Section 7(a)(1) duty to determine how EPA can use its authority to enhance the recovery of these listed species. In addition, the funding for the research that is needed in this area should come from operating and proposed fossil power plant operators.

C. EPA's new technical analyses reaffirm that it is appropriate and necessary to regulate U.S. Hazardous Air Pollutants ("HAP") from coal- and oil-fired electric utility steam generating units ("EGUs")

EPA's determination in 2000 that it was appropriate and necessary to regulate HAP from U.S. EGU required that the Agency set toxic air pollution standards for these facilities (see infra, chapter II). Nonetheless, EPA has conducted new and extensive technical analyses prior to publication of the 2011 proposed rule. These analyses, although not required, reaffirm the 2000 finding that regulation of toxic air pollution from EGUs under section 112 is appropriate and necessary. Additionally, the new technical analyses incorporate present and future projections of HAP emissions, modern air pollution modeling tools, current control technologies, and updated pollutant emissions regulations. The results clearly demonstrate that not

only was the 2000 decision justified at the time, but that 11 years later, the science shows that it is even more critical to regulate HAP emissions from U.S. EGUs.

1. HAP Emissions from U.S. EGUs Continue to Pose Health and Environment Hazards

In the 2011 proposal, three distinct quantitative and qualitative technical analyses were conducted by EPA that determined HAP emissions from U.S. EGUs contributed to the risk of adverse effects to public health or the environment. These were: (i) EPA's national-scale mercury risk assessment; (ii) EPA's case studies of cancer and non-cancer inhalation risks for non-Hg HAP; and (iii) EPA's qualitative assessment of potential environmental risks from deposition of HAP. The results from all three risk analyses conducted indicate that HAP from U.S. EGUs pose hazards to public health and the environment.

a. EPA's National-Scale Mercury ("Hg") Risk Assessment Demonstrates that U.S. EGU Hg Emissions Pose a Hazard to Public Health

First, EPA conducted a comprehensive technical analysis that quantified the potential risk to public health posed by U.S. EGU Hg emissions. The results of the assessment clearly indicate that Hg emitted by U.S. EGUs currently poses a hazard to public health and will continue to do so in the future. This assessment analyzes human exposure to methylmercury ("MeHg") through ingestion of fish from U.S. freshwater lakes and streams and does not quantify adverse effects from the ingestion of MeHg

in seafood. Were EPA to take into account consumption of seafood, MeHg consumption in the U.S. is of even greater concern. A recent study focused on estuarine and marine fish consumption in the U.S. finds that seafood significantly contributes to national exposure to MeHg.[120] This study considers differences in fish intake and geographic variability of seafood. The results indicate that seafood consumption under certain conditions can cause exposures to women of child-bearing age above EPA's reference dose (RfD) for MeHg.[121] Subpopulations with heavy intakes of regional seafood may also be at risk. For example, one study on recreational anglers finds that these subpopulations have high levels of exposure to MeHg, which the study largely attributed to recreationally caught seafood.[122] Results from a different study indicate that women of child-bearing age living in coastal areas are at considerably higher risk of having blood Hg concentrations exceeding acceptable health-based levels due to higher consumption of fish and shellfish.[123] Although a

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[120] Elsie M. Sunderland, *Mercury Exposure from Domestic and Imported Estuarine and Marine Fish in the U.S. Seafood Market*, 115 Envtl. Health Persp. 239 (2007), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1817718/.

[121] *Id.* at 241.

[122] Rebecca A. Lincoln et al., *Fish Consumption and Mercury Exposure among Louisiana Recreational Anglers*, 119 Envtl. Health Persp. 248-249 (2011), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3040613/.

[123] Kathryn R. Mahaffey et al., *Adult Women's Blood Mercury Concentrations Vary Regionally in the United States: Association with Patterns of Fish Consumption (NHANES*

much smaller effect on seafood MeHg levels is anticipated from this rule compared to that in freshwater fish, emissions from U.S. EGUs nevertheless contribute to the global problem of marine MeHg bioaccumulation. Ingestion of seafood could further increase the impact of Hg emissions from EGUs on public health beyond that estimated from an analysis based exclusively on consumption of freshwater fish.

EPA's determination that Hg emissions pose a risk to public health is based on a MeHg reference dose (RfD) of 0.1 µg/kg per day. 76 Fed. Reg. at 25,000. The Rfd for MeHg is the daily amount of MeHg ingestion expected not to produce adverse health effects to the most sensitive subpopulations over a lifetime. The utility industry has argued that this RfD is too conservative.[124] Rather than being too conservative, this RfD is based on sound science. Further, Section 112 of the Clean Air Act acknowledges the particular danger posed by the congressionallylisted HAPs and takes an intentionally conservative approach to protecting human health. For example, when Congress passed the Clean Air Amendments of 1990, it shifted the burden of proving a substance's health hazard from those who support regulation to those that oppose regulation. See Section 112(b)(3) (requiring those who wish to remove a substance from the congressionally-created list of HAPs to provide

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1999–2004), 117 Envtl. Health Persp. 51 (2009), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2627864/.

[124] Comments of Utility Air Regulatory Group, Docket ID No. OAR-2002-0056, at 16- 18 (June 29, 2004).

"adequate data [showing] the substance may not reasonably be anticipated to cause any adverse effects to human health or adverse environmental effects"). Given the overall emphasis on protecting human health, if faced with two alternatives methods of determining RfD, it is reasonable for the Agency to choose the method that is more conservative with respect to human health. Thus, EPA has applied an appropriate RfD in its analysis based Faroe Islands study, a decison supported by the findings of the National Academy of Sciences' Study on Mercury. 76 Fed. Reg. at 25,000.

In the 2000 determination, some utility groups took issue with EPA's reliance on a Faroe Islands study to determine a proper RfD.[125] This industry argument was largely based on the fact that (1) Faroe Islanders were exposed to high levels of polychlorinated biphenyl in addition to mercury and (2) the diet of Faroe Islanders differed from that of Americans.[126] However, this argument fails to acknowledge that the findings of the Faroe Island study were consistent with a smaller study conducted in New Zealand (0.1 µg/kg-day) for which neither of these issues was present. 76 Fed. Reg. at 25,000. Further, analyses done since 2000 integrating data from both the Faroe Island and New Zealand studies with a third study conducted in the Seychelles demonstrate a significant relationship

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[125] *Id.*

[126] *Id.*

between prenatal MeHg exposure and neurobehavioral deficits.[127]

Since the 2000 Finding, additional studies from Poland and the United States support the conclusion of the New Zealand, Faroe Island, and Seychelles studies, and find that there is a negative correlation between maternal mercury levels and neurological development.[128] These more recent studies, also find a clear associations between maternal blood Hg levels and delayed child development using new cohorts based on urban populations.

Finally, the RfD applied by EPA in this assessment is based on neurobehavioral test results. Other potential health impacts of prenatal mercury exposure have been identified. For example, an association between cardiovascular effects and MeHg exposure has been reported. A recent study finds significant associations between mercury exposure

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[127] Daniel A. Axelrad, *Dose-Response Relationship of Prenatal Mercury Exposure and IQ: An Integrative Analysis of Epidemiologic Data*, 115 Envtl. Health Persp. 609 (2007), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1852694/.

[128] See Wieslaw Jedrychowski et al., *Effects of Prenatal Exposure to Mercury on Cognitive and Psychomotor Function in One-Year-Old Infants: Epidemiologic Cohort Study in Poland*, 16 Annals of Epidemiology 439 (2006), abstract available at http://www.mendeley.com/research/effects-prenatal-exposure-mercury-cognitivepsychomotor- function-oneyearold-infants-epidemiologic-cohort-study-poland/; S.A. Lederman et al., *Relation Between Cord Blood Mercury Levels and Early Child Development in a World Trade Center Cohort*, 116 Envtl. Health Persp. 1085 (2008), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2516590/.

and indicators of cardiovascular disease.[129] Additionally, the potential effects of co-pollutants, those derived from exposures to pollutant mixtures, related to MeHg are ignored in the Agency's assessment. One recent study finds that such an omission may lead to additional health effect associated with MeHg exposure being overlooked.[130] This study identifies health effects associated with prenatal lead exposure when simultaneously exposed to MeHg.

EPA's national-scale assessment unequivocally identifies public health risks associated with Hg emissions from U.S. EGUs. The assessment results indicate that:

- EGU-attributable MeHg poses a hazard to public health at 28 percent of watersheds analyzed when considering all sources of Hg deposition. 76 Fed. Reg. at 25,010.

- Hg deposition attributable to U.S. EGUs alone poses a health risk at 12 percent of the watersheds analyzed without considering any other Hg source. *Id.*

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[129] Anna L. Choi et al., *Methylmercury Exposure and Adverse Cardiovascular Effects in Faroese Whaling Men*, 117 Envtl. Health Persp. 367 (2009), available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2661905/.

[130] Takasi Yorifuji et al., *Parental Exposure to lead and cognitive deficit in 7- and 14- Year-Old Children in Presence of Concomitant Exposure to Similar Molar Concentration of Methylmercury*, 33 Neurotoxicology & Teratology 205 (2011), abstract available at http://www.sciencedirect.com/science/article/pii/S0892036210001686.

- The contribution of U.S. EGUs to total Hg deposition may be greater than 10 percent at hundreds of watersheds. *Id.* at 25,009.

Additionally, the quantitative and qualitative sensitivity analyses completed by EPA for the most significant uncertainties in the analysis indicate that these uncertainties should not alter the Agency's conclusions. Id. at 25,011. EPA further acknowledges that limitations in the availability of fish tissue MeHg data could be leading to a substantial underestimation of the number of watersheds where populations are at risk of exposure to EGU-attributable MeHg. Thus, the Agency reasonably determined that mercury emissions pose a public health hazard, and regulation of EGUs is appropriate. EPA has correctly requested peer-review of national-scale risk analysis. The Agency will consider the results of the peer review prior to the final rule publication and make these available along with the Agency's response.

b. EPA's Case Studies For Non-Hg HAP Demonstrate That Non-Hg HAP from U.S. EGUs Pose a Hazard to Public Health

Although the risk to public health and the environment posed by Hg is sufficient to require regulation of HAP emissions from EGUs (see chapter 2, infra), EPA's risk assessment for non-Hg HAP demonstrates additional potential public health impacts and clearly calls for regulation. EPA conducted 16 test cases quantifying the health risk from chronic inhalation of non-Hg HAP from EGUs. Over 40 percent of the case studies conducted by

EPA to quantify health hazards associated with the inhalation of non-Hg HAP indicated a cancer risk greater than or equal to the one in one million threshold level threshold required to delist a source as a category regulated under section 112 of the Clean Air Act. 76 Fed. Reg. at 25,011; *see also* Section 112(c)(9)(B) (indicates that "no source in the category emits [carcinogenic] air pollutants in quantities which may cause a lifetime risk of cancer greater than one in one million to the individual in the population who is most exposed to emissions of such pollutants from the source."). The case study examining cancer risk from an oil-fired EGU indicated that the greatest cancer risk estimate quantified in the assessment, ten in one million, is associated with this source. 76 Fed. Reg. at 25,012. This reaffirms the need to regulate HAP emitted by both coal- and oil-fired EGUs.

In addition to other metallic HAP, there are several acid gases emitted by EGUs that also support regulation which were not included in the test cases. Studies of these acid gases were not included due to uncertainties in their emission rates. Potential overlapping impacts from different EGUs and other pollutant sources were also not quantified. All of these additional factors likely compound the cancer risks estimated in the case studies. We agree with EPA's decision to only peer-review the speciation of chromium and nickel in the analysis of the health risks posed by non-Hg EGU emissions. The AERMOD modeling system methodology applied in EPA's non-Hg HAP chronic inhalation test cases is well established and has undergone numerous evaluations. For example, one recent comparative

study finds that AERMOD produces the most reliable exposure risk simulation results among four different common exposure assessment methods.[131]

c. EPA's Qualitative Assessment of Potential Environmental HAP Impacts Indicates that HAP Emissions from U.S. EGUs Pose a Hazard to the Environment

When it made the 2000 Finding, EPA included evidence of adverse effects of mercury on the environment, which has been further supported by newer studies. Several of these newer studies are included in a special issue published by the journal Ecotoxicology in 2008 devoted to the effects of MeHg on wildlife.[132] Although EPA has not quantified the potential impacts of HAP from U.S. EGUs on the environment, a qualitative assessment conducted by the Agency reviewed existing literature reporting effects of Hg on fish and wildlife and acid gas contribution to ecosystem acidification. The potential adverse environmental effects associated with HAP are well documented and have been previously described in section (B) of this chapter. This qualitative assessment reaffirms EPA's

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[131] Bin Zou, *How should environmental exposure risk be assessed? A comparison of four methods for exposure assessment of air pollutions*, 166 Envtl. Monitoring & Assessment. 166 (2010), abstract available at http://www.springerlink.com /content/a68l242m75215377/.

[132] Special Issue on Effects of Methyl Mercury on Wildlife, 17 Ecotoxicology 67–171 (2008), available at http://www.springerlink.com/content/vtj02mn13516/?p=8f4430c 82b2e48c3af1dbabf5 799fdb6&pi=2

determination that it is appropriate and necessary to regulate HAP emissions from EGUs.

.2. EPA's Analyses Demonstrate that EGUs Remain the Largest Source of Hg, Hydrogen Chloride ("HCl"), Hydrogen Fluoride ("HF"), and Selenium, ("Se") in the U.S., as Well as a Major Source of Hydrogen Cyanide ("HCN") and Other Metallic HAP

The technical analyses conducted by EPA demonstrate that EGUs remain the largest source of Hg in the United States, accounting for approximately half of U.S. anthropogenic Hg emissions. 76 Fed. Reg. at 25,002. Hg emissions from EGUs are projected to remain relatively unchanged through 2016 and then be over six times larger than those from the second largest contributing source. Id. Additionally, the significant fractions of oxidized and particulate Hg in Hg emissions from EGUs make these emissions more relevant to local and regional deposition than natural emissions comprised of elemental Hg. In 2005, EGUs accounted for 82 percent of HCl emissions, 62 percent of HF emissions, 8 percent of HCN emissions, and 13 to 83 percent of several non-Hg metallic HAP emissions in the U.S. Id. at 25,005.

a. EPA's National-Scale Hg Risk Assessment Demonstrates that EGUs Can Significantly Contribute to Hg Deposition

EPA's national-scale Hg risk assessment demonstrates that U.S. EGUs can significantly contribute to watershed Hg deposition. High variability in the contribution of U.S. EGUs to total Hg deposition is evident from the analysis, id. at

25,008. EPA's modeling results indicate that the fraction of total Hg deposition attributable to EGUs is greater than 10 percent at hundreds of watersheds., id. at 25,009. As previously discussed, the Hg deposition attributable to U.S. EGUs alone may endanger sensitive populations near many of these watersheds. Thus, there are many areas of the nation for which EGUs are a significant contributor to potential Hg hazards to public health and the environment.

b. EPA's Local Hg Deposition Analysis Demonstrates that Areas Close to EGUs are at Greater Risk for Adverse Public Health and Environmental Effects

EPA has also demonstrated that deposition of Hg emitted by EGUs can be significantly larger at locations close to emission sources. The Agency's assessment of potential for deposition "hotspots" shows that Hg deposition near EGUs can be three times as large as the regional average. Id. at 25,013. This excess Hg deposition would substantially increase the health and environmental risks associated with emissions at these sites. Furthermore, the methodology applied by EPA to quantify near-source Hg deposition is conservative. In EPA's analysis, the average local deposition is estimated from the area within 50 km of the EGU source. This method averages local Hg deposition across a large area (over 7500 km2). Maximum excess local Hg deposition may be significantly underestimated by averaging high deposition sites downwind of an EGU in the direction of prevailing winds with lower excess deposition at locations close

to but frequently upwind of the facility. A more rigorous alternative approach would be to identify potential "hotspots" from the modeled Hg deposition at individual grid cells within the modeling domain. For this technical analysis, the Community Multiscale Air Quality model used by EPA estimates Hg deposition individually for 144 km2 extensions of land corresponding to the 12 km model resolution selected.[133] The use of individual 144 km¬2 grid cells to quantify local deposition could increase the excesses Hg deposition at these locations significantly and place them at even greater risk of adverse health and environmental effects of HAP from U.S. EGUs. Though this alternative methodology might indicate the likelihood of much higher concentrations, EPA's methodology nonetheless quite clearly demonstrates that excess Hg deposition occurs in the vicinity of EGUs and is especially significant around the largest Hg emitters.

3. EPA's Analysis of Control Technologies for EGU HAP Demonstrates that Significant Emissions Reductions Can be Achieved with Available Controls

In its analysis, EPA identified the current control technologies available for HAP from U.S. EGUs and estimated the controls' expected impact on national total and category-specific emissions. The Agency's analysis identifies multiple available control technologies that would enable EGUs to comply with regulations, including electrostatic precipitators, fabric filters, flue gas desulfurization, activated

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[133] Regulatory Impact Analysis of the Proposed Toxics Rule, Docket ID No. OAR- 2011-0044, at 3-2 (March, 2011).

carbon injection, and dry sorbent injection. Furthermore, significant reductions to Hg emissions may already be occurring at EGUs that have installed controls intended for other pollutants, such as particulate matter or sulfur oxides. 76 Fed. Reg. at 25,017. Available control technologies for metal HAP and acid gases were also identified by EPA. As for Hg, the analysis finds that effective control of non-Hg HAP may be achieved as a co-benefit of particulate matter and sulfur oxides controls.

EPA's emissions projections clearly show that vast reductions to emitted HAP would result from this rule. Compliance with the rule is estimated to result in 79 and 91 percent reductions to U.S. EGU Hg and hydrochloric acid respectively. The reductions are also equivalent to 36 and 49 percent of national anthropogenic Hg and hydrochloric acid emissions respectively. The reduction in metallic HAP is projected to equal approximately 430 tons per year. These great reductions to U.S. HAP expected to result from this rule incontestably demonstrate that the proposed rule will produce effective results.

4. EPA's New Technical Analysis Provides Compelling Evidence that Demonstrates it is Appropriate and Necessary to Regulate HAP from U.S. EGUs

We commend EPA on the extensive technical analyses undertaken by the Agency prior to publication of this proposed rule. The science behind EPA's new technical analyses is comprehensive and robust. The technical analyses clearly demonstrate that HAP form U.S. EGUs pose a risk to public health and the environment. The new analysis

reaffirms that utilities are the largest domestic source of Hg and a major source of non-Hg HAP. Proven effective control technologies for EGU HAP are available. The analyses incorporate updated data, newly published information, and current modeling tools. The Agency's assessments clearly show that HAP from U.S. EGUs pose hazards to public health and the environment after considering the requirements of the Clean Air Act.

{Environmental Defense Fund, Comments on Proposed Rule, (submitted August 4, 2011) (Docket No. EPA-HQ-OAR-2009-0234-18421) (excerpt)}

[Page 3]

I. Health and Environmental Threats of Hazardous Air Pollutants from Electric Generating Units

Hazardous air pollutants (HAP) pose a significant risk to human health and welfare. HAPs are pollutants that are known or suspected to cause cancer or other serious health and environmental impacts. Humans are exposed to HAP by breathing in contaminated air, consuming contaminated food or water, ingesting contaminated soil (children, particularly), or even through touching contaminated soil, dust, or water.[1] Congress deliberately identified 188 hazardous air pollutants in the 1990 Clean Air Act Amendments and required that emissions standards be set for listed (stationary) sources of those pollutants. Power plants emit 84 different HAP and are responsible for nearly half of all manmade mercury emissions, 76 percent of acid gases, and a quarter of all toxic metal emissions.[2]

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[1] Environmental Protection Agency, *Toxic Air Pollutants*, http://www.epa.gov/air/toxicair/newtoxics.html (last visited June 12, 2011).

[2] Environmental Protection Agency, *National Emission Inventory (NEI) 2002: Inventory Data: Point Sector Data – ALLNEI HAP Annual 01232008*, ftp://ftp.epa.gov/EmisInventory/2002finalnei/2002_final_v3_200

a. Mercury

Mercury is a potent neurotoxin that bioaccumulates in the food chain. Mercury in the air settles into surface waters or onto land where it is washed into water. Deposited in lakes and ponds, this mercury is converted by certain microorganisms to a highly toxic form of the chemical known as methylmercury. Methylmercury (MeHg) accumulates in fish and shellfish, as well as birds and mammals that consume fish. Fish and shellfish are the main sources of human methylmercury exposure.

Pregnant women are cautioned against consuming fish known to have high levels of mercury to avoid potentially deleterious impacts on their unborn children. Exposure to methylmercury in the womb can cause children to have lower IQ, have difficulty thinking and learning later in life, and can impact development of the central nervous system. It is estimated that hundreds of thousands of newborns each year have been exposed to unsafe levels of methylmercury in utero. An analysis by Dr. Kathryn Mahaffey in 2006 estimated that approximately 410,000 infants are born annually in the U.S. to mothers with blood mercury concentrations in excess of EPA's Reference Dose.[3] Methylmercury can also be transferred from breastfeeding mothers to their infants.[4] The National Academy of Sciences' National

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7_summaries/point/allnei_hap_annual_01232008.z ip (last visited Jan. 11, 2011).

[3] Kathryn R. Mahaffey, NHANES 1999-2002, Update on Mercury & Northeast Regional Mercury Conference, U.S. EPA (Apr. 2006).

[4] Bose-O'Reilly et al, *Mercury Exposure and Children's Health*, Curr Probl Pediatr Adolesc Health Care. 2010 September;

Research Council found that the brain development of infants and young children is threatened by chronic, low-dose environmental exposures to methylmercury:

> *Chronic, low-dose prenatal MeHg exposure from maternal consumption of fish has been associated with more subtle end points of neurotoxicity in children. Those end points include poor performance on neurobehavioral tests, particularly*

[Page 4]

> *on tests of attention, fine-motor function, language, visual-spatial abilities (e.g., drawing), and verbal memory.*[5]

In fact, in a toxicological assessment of methylmercury-related health effects in 2000, the National Research Council (NRC) concluded that neurodevelopmental impacts from prenatal MeHg exposures are the most sensitive and well-documented health endpoint (NRC 2000)[6] In children, low-dose exposures to methylmercury may produce deficits in vision and hearing, delayed

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40(8): 186–215. doi:10.1016/j.cppeds.2010.07.002. [hereinafter Bose-O'Reilly 2010].

[5] National Academy of Sciences National Research Council, *Toxicological Effects of Methylmercury* 4 (2000), *available at* http://www.nap.edu/catalog/9899.html.

[6] *Id.*

walking and speech development, and other developmental delays.[7]

Many places around the United States are hotspots for mercury exposure. A recent study of women conducted in Durham, North Carolina, for instance, found that nearly 30 percent of the women participating in the study had at least 1 µg/L of mercury in their blood and approximately 2 percent had blood mercury levels above 3.5 µg/L, considered to be the level of concern during pregnancy.[8] It is important to note that exposures to mercury below 3.5 µg/L have been linked to neurological development delays and preterm birth.[9] Of those participants of Asian/Pacific Islander descent in the study, 12.5 percent had levels of mercury above the level of concern.

Certain regions and ecosystems may be at more risk from mercury than others. A study focused on South Florida demonstrated that sulfates increased formation of methylmercury and other pollutants like phosphate. The regional consequence is that fish in the Everglades have among the highest mercury levels in Florida.[10] The report also found limited evidence of adverse cardiovascular effects at similar

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[7] Castoldi, Coccini, Ceccatelli, & Manzo, *Neurotoxicity and molecular effects of methylmercury*, 55 Brain Res. Bull. 197, 203 (2001).

[8] Miranda et al., Mercury Levels in an Urban Pregnant Population in Durham County, 8 North Carolina. Int. J. Environ. Res. Public Health 698, 698-712 (2011).

[9] *Id.*

[10] South Florida Water Management District, 2011 South Florida Environmental Report Chapter 3B (2011).

levels of exposure, but did not reach firm conclusions on the cardiovascular impact of MeHg intake.

As EPA has recognized, mercury pollution can have a disproportionate impact on lowincome, subsistence fishers, and communities of color. A recent analysis by the Sierra Club corroborates the disproportionate impact methylmercury can have on the Hispanic community because of cultural, linguistic, and economic factors.[11] The analysis found that, because Hispanics in the US are more likely to catch and consume fish from local waterways, they are at greater risk of exposure to toxic mercury.[12]

While neurological and developmental effects have been documented as the most sensitive endpoints, there is some evidence linking methylmercury exposure to acute myocardial

[Page 5]
infarction (AMI) and mortality. A 2005 report by Northeast States for Coordinated Air Use Management examined four studies linking MeHg exposure to AMI. One of the studies examining men in Eastern Finland even found a 9 percent increased risk of all mortality for each increase of 1 ppm in hair mercury percent.[13] A study examining 274

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[11] Sierra Club, *New Analysis Finds that Hispanics Face Disproportionate Health Threat from Coal Plant's Toxic Mercury Pollution*(June 14, 2011).

[12] *Id.*

[13] Salonen, J.T., K. Seppänen, T.A. Lakka, R. Salonen and G.A. Kaplan, *Mercury accumulation and accelerated progression of carotid atherosclerosis: A population based prospective 4-year*

children in Korea found an association between mercury concentrations in urine and increased cholesterol, which is a risk factor for various forms of cardiovascular impacts.[14]

Another study in Korea identified a link between adult leukemia and exposure to high levels of methylmercury.[15] In Minamata, Japan a MeHg outbreak occurred where the local population was exposed to severely elevated levels of MeHg from decades-long releases from a nearby chemical plant. The local population consumed high levels of contaminated fish; and mothers, typically not exhibiting symptoms themselves, gave birth to children with severe neurological and birth defects. Additionally, a retrospective study on the affected population noted an increase in the number of stillbirths among male infants, indicating a possible increased risk of male fetal mortality.[16] The Iraq outbreak of mercury poisoning from contaminated seed grains also evidences serious reproductive impacts resulting from exposure to mercury. In this case, the outbreak was associated with lower than normal levels of pregnancies among the affected population.[17]

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follow-up study in men in Eastern Finland, Atherosclerosis. 148, 265-273 (2000).

[14] Bose-O'Reilly 2010, *supra* note 4.

[15] Yorifuji T, Tsuda T, Kawakami N, *Age standardized cancer mortality ratios in areas heavily exposed to methyl mercury*, 88Int. Arch. Occup. Environ. Health. 679, 679-88 (2007).

[16] Bose-O'Reilly 2010, *supra* note 4.

[17] Bose-O'Reilly 2010, *supra* note 4.

b. Non-Hg metals

Non-mercury metals that will be reduced by the proposed rule when it is in place include antimony, arsenic, beryllium, cadmium, chromium, nickel, selenium, and manganese. Some of these metals are known carcinogens and can cause cancer of the lung, kidney, bladder, and skin.[18] These metals may also harm various systems of the human body including, immune, cardiovascular, nervous, and respiratory.[19]

Lead is another toxic metal that will be reduced when the proposed rule is in place. The human health impacts of lead are well-documented, particularly the cognitive impacts on children. Lead can result in lowered intelligence quotients (IQ), learning and behavioral problems, slowed body growth, kidney damage, and other serious health impacts.[20]

c. Acid gases

[Page 6]

Coal-fired power plants are responsible for approximately 76 percent of all acid gas emissions in the US.[21] Acid gases, like hydrogen chloride and hydrogen fluoride, are corrosive gases emitted by coal-fired power plants that can irritate the nose,

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[18] Agency for Toxic Substances and Disease Registry, Toxic Substances Release Portal, http://www.atsdr.cdc.gov/substances/index.asp (last visited July 2011).

[19] *Id.*.

[20] U.S. National Library of Medicine,*Lead Poisoning*, http://www.nlm.nih.gov/medlineplus/ency/article/002473.html. (last visited June 12, 2011).

[21] *Id.*

throat, and respiratory tract. Acid gas vapors are highly water soluble and can therefore "readily react with the moisuture/tissues in the upper airways."[22] Furthermore, "water bound to microscopic particles can act as a 'delivery system' for acids to the alveolar regions of the lung."[23] It has been demonstrated that people with asthma experience irritation and restriction of airways from exposure to hydrogen chloride.[24] According to EPA, the greatest impact of hydrogen chloride is on the upper respiratory tract, high concentrations of which can lead to human health impacts as severe as suffocation.[25]

As EPA and other experts note, children are likely more vulnerable to air pollution such as acid gases because their airways are less developed, they have faster breathing rates than adults, and typically spend more time outdoors compared to adults.[26] Two studies referenced in the Environmental Health and Engineering Memorandum echo this conclusion. One study of 13,000 children in 1996 found an association between strongly acidic particles and increased cases of bronchitis and reduced lung function.[27] The study

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[22] Environmental Health and Engineering, Memorandum from David L. McIntosh to Janice E. Nolen, American Lung Association, *Acid Gas Emissions and Coal-Fired Power Plants*. March 2, 2011. [hereinafter EHE Acid Gas].

[23] *Id.*

[24] *Id.*

[25] Regulatory Impact Analysis of the Proposed Toxics Rule: Final Report, March 2011.

[26] EHE Acid Gas, *supra* note 23.

[27] Raizenne M, Neas LM, Damokosh AI, Dockery DW, Spengler JD, Koutrakis P, Ware JH, Speizer FE, *Health Effects of Acid*

also found that acid gases were associated with asthma in children. The second study from 2004 reaffirmed the link between particle pollution and acid gases with reduced lung function in children.[28]

Acid gas emissions can also impact ecosystems. Hydrogen chloride can make rain more acidic than usual, contributing to acid rain formation, which can harm human health, waters, wildlife, forests, and vegetation.[29] In fact, a recent study from the United Kingdom found that almost a third of the reductions achieved there in acid rain contamination are attributable to reductions made in coal power plant emissions of hydrogen chloride.[30]

[Page 7]

d. Organic hazardous air pollutants

Organic HAP, specifically dioxins and furans that are formed during coal combustion, are probable carcinogens that are linked to a variety of cancers. Dioxins and furans may also cause reproductive and developmental problems, damage the immune

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Aerosols on North American Children: Pulmonary Function, 104 Environmental Health Perspectives 506, 506-14 (1996).

[28] Gauderman WJ, Avol E, Gilliland F, Vora H, Thomas D, Berhane K, McConnell R, Kuenzli N, Lurmann F, Rappaport E, Margolis H, Bates D, *The effect of air pollution on lung function development in children aged 10 to 18 years*, 351 New England Journal of Medicine 1057-67 (2004).

[29] The Environment Agency of the United Kingdom, http://www.environmentagency.gov.uk/business/topics/pollution/283.aspx. (last visited June 6, 2011).

[30] Evans CD, Monteith DT, Fowler D, Cape JN, Brayshaw S. 2011. Hydrochloric Acid: An Overlooked Driver of Environmental Change. Environmental Science & Technology (In Press, DOI: dx.doi.org/10.1021/es103574u).

system, and interfere with hormones.[31] Once dioxins enter the body, they can stay there for a long time because of their chemical composition and ability to be stored in fat tissue.[32] Dioxins' half-life in humans is estimated to be 7–11 years.[33] Dioxins emitted to the air can stay there for over 10 days and people can be exposed through direct inhalation.[34] These airborne particle-bound dioxins are deposited on land and in water and can stay there for years. Dioxins bioaccumulate in the food chain and humans can be exposed when consuming contaminated meat or fish.[35] Developing fetuses are the most sensitive group for exposure to dioxin.[36] Dioxins have even been detected in nursing mothers' breast milk.[37] In utero and breast feeding exposure to environmental contaminants, like dioxins, may cause attention deficit disorder or learning disabilities in children.[38]

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[31] Environmental Health and Engineering, *Emissions of Hazardous Air Pollutants from Coal-fired Power Plants*. March 7, 2011. [hereinafter EHE HAP Emissions].

[32] World Health Organization. Fact sheet: "Dioxins and their effects on human health," May 2010. [hereinafter WHO Fact Sheet].

[33] *Id.*

[34] EHE HAP Emissions, *supra* note 31..

[35] *Id.*

[36] WHO Fact Sheet, *supra* note 32.

[37] EHE HAP Emissions, *supra* note 31.

[38] Nakano, Shiro et. al, *Chlorella (Chlorella pyrenoidosa) Supplementation Decreases Dioxin and Increases Immunoglobulin A Concentrations in Breast Milk*, 10 J Med Food. 134, 134-42 (2007)..

{EPRI Comments on Proposed HAPs MACT Rule
4 August 2011}

[Page viii]

- The Electronic Reporting Tool (ERT) has severe limitations for reporting compliance test results and needs extensive revision before it is used for that purpose.

Key Comment on Environmental Fate and Transport, Exposure and Human Health Issues, and Risk Analyses

EPA has failed to conduct scientifically rigorous analyses of the health risks associated with exposure to mercury, other hazardous air pollutants and particulate matter by not documenting its assumptions, using substandard methods, and excluding the highest quality/most recently available information.

As in the case of Proposed MACT Limits and Fuels, Emissions and Controls, EPRI's ability to comment was challenged by the lack of documentation for data and underlying assumptions in EPA's analyses of the fate, transport, and risk associated with exposure to mercury and other HAPs. Further, the Agency's methods, tools, and input assumptions lacked scientific quality in addressing such an important societal issue. As the risk analyses provide the basis for requiring controls on HAPs emissions and the benefits derived from those controls, it is of critical importance that the most scientifically defensible methods and data be used. For example, as pointed out below, the Community Multiscale Air Quality (CMAQ) and Mercury Maps (MMaps) models have

limited capabilities to adequately determine mercury deposition and bioaccumulation in fish. EPA's risk assessment methodology contains numerous errors leading to overestimates. Despite these flaws and errors, the primary health benefit is stated to be fine particulate matter ($PM_{2.5}$) concentration reductions in areas which already meet the $PM_{2.5}$ standard.

Specific Comments on the Environmental Fate and Transport, Exposure and Human Health Issues, and Risk Analyses

Specific comments on Environmental Fate and Transport, Exposure and Human Health Issues, and Risk Analyses are presented below. The more detailed comments are in Section 3 and in Appendices E–J.

- There is no evidence of mercury "hot spots" due to local deposition associated with coal-fired power plants. In fact, EPA does not adequately define a "hot spot" and its definition has changed over time. Data indicate that 91–96% of mercury emitted from power plants travels more than 50 kilometers (km) from the plant site, thus making "hot spots" unlikely.

- EPA did not provide a rigorous scientific validation of the mercury deposition estimated by its CMAQ model. For example, EPA did not employ the Advanced Plume Treatment module that more accurately simulates wet and dry deposition. Nor did EPA include new findings on in-plume conversion of reactive gaseous mercury to elemental mercury. The latter findings were part of an EPA study but were not incorporated in

the risk assessment. In some cases, CMAQ predicted negative values for wet deposition, which is physically impossible.

- EPA employs MMaps to establish the relationship between mercury deposition and fish tissue methylmercury (MeHg) levels. While acknowledging its limitations, the Agency states that it is unaware of any other tool to do such analyses. The Mercury Cycling Model (MCM) developed by EPRI is a more rigorous tool that has been used for this purpose.

[Page ix]

- EPA assumes a steady-state linear relationship between changes in mercury deposition and fish MeHg tissue levels. Data that demonstrate a steady-state linear reduction in fish tissue MeHg in response to a reduction in atmospheric mercury deposition within watersheds do not exist. EPA needs to provide scientific evidence for such linear relationships within watersheds and an assessment of other models to allow comparison with MMaps.

- EPA uses poorly documented population and exposure assumptions in deriving estimates of people at risk from exposure to mercury. For example, the estimate of the amount of fish consumed by various sensitive population groups is not supported or documented sufficiently to conduct sensitivity analyses, and is drawn from small populations. Further, EPA assumes that poverty is a direct indication of subsistence fishing and high end fish consumption, but there

is no documentation supporting these assumptions. EPA provides no clear definition of subsistence, near subsistence, or high end fish consumption.

- EPA does not justify selective cooking loss concentration factors for estimating fish MeHg levels. Studies vary on this factor, which is critical in determining overall risk. EPA's choice of a 1.5 concentration factor increases daily MeHg intake by 33%.

- In conducting its health risk assessment, EPA continues to rely on a reference dose (RfD) based primarily on data from the Faroe Islands that claims to have demonstrated no threshold for mercury health effects, despite the fact that neither EPA nor others have been able to acquire and model the Faroe data to confirm this conclusion. Iraqi and Seychelles data, on the other hand, do indicate a threshold effect. Selection of a threshold versus no threshold effect is critical since mercury exposure levels in U.S. women are lower than those observed in the Faroe Island study, which was used to derive EPA's mercury RfD and to help derive the intelligence quotient (IQ) response estimates in EPA's *Regulatory Impact Analysis*. Further complicating this issue is the fact that the endpoint of the Faroe Islands study was not IQ impact, but neurobehavioral changes.

- Changes in IQ are not a well defined health consequence of methylmercury exposure, and those IQ relationships that have been developed

were done for mercury in marine fish, not freshwater fish.

- EPA's risk assessment methodology contains flaws and errors in input assumptions that lead to an overestimate of risk, particularly at those power plants whose risks were calculated to be at or above 1 in a million. EPA's use of the arithmetic mean to determine emission factors for a lognormally distributed data set is inappropriate; a geometric mean should be used. EPRI identified suspected chromium contamination at three case study sites, as well as 14 EGUs; these suspect data should not be used in calculating risks. This raises questions regarding the implications of these flaws and errors for all other power plant emissions and for the overall MACT rule. Results of EPRI's previous risk analyses, using different emissions estimates and updated stack parameters, indicate that no coal-fired facilities exceed the 1 in a million cancer risk threshold.

- Despite these shortcomings in EPA's risk analyses for mercury and other HAPs, the primary health benefit of the proposed rule comes from reductions in $PM_{2.5}$ concentrations. However, over 99.5% of the health benefits would occur in regions of the United States where $PM_{2.5}$ is currently in compliance with the ambient standard. Compliance with an EPA ambient standard, by definition, means that the air is healthy to breathe; thus, any further reduction in $PM_{2.5}$ concentrations below the ambient standard should have minimal health benefits. In

[Page x]

fact, over 70% of the calculated health benefits are in areas where the $PM_{2.5}$ concentration is less than 10 micrograms per cubic meter.

- It appears that EPA may have "double counted" in assigning health benefits to the proposed HAPs MACT rule. EPA needs to clearly articulate the individual benefits assigned to all of its pending air rules, including the new PM ambient standard, the Cross State Air Pollution Rule, and the short-term sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) primary ambient standards.

- EPA's use of studies to derive the dose-response function for $PM_{2.5}$ relied on only two studies, not a balanced review of the published literature. Many studies were dismissed as having populations of a "selective nature" but this is true of all studies, including those used by EPA. Thus, EPA should use the entirety of the results from the literature, not a selected subset.

- The methodology used by EPA for benefits assessment appears to be flawed, based on recent analyses. A reanalysis of data from one study suggested that there is not "any change in life expectancy for a reduction of $PM_{2.5}$." EPA also ignores any differential toxicity of PM species, which needs to be discussed in the context of potential health benefits of SO_2 reductions (and thus sulfate reductions) as a result of compliance with the HAPs MACT rule.

- EPA states that it is concerned about the impacts of HCl and other acid gas emissions on the

environment. This statement is based on a study of waterbodies in the United Kingdom. However, the U.K. study results are inappropriate to apply in the United States because U.S. coals differ from U.K. coals in chloride content (U.S. coals have much lower chloride concentrations) and U.S. soils differ from U.K. soils (U.S. soils are limited in areas containing histosols). Further, the study claims that chloride is not taken up by plants and soils; however, other researchers are finding that there is some retention that would lessen chloride impacts even further. Lastly, HCl emissions are negligible compared to other primary emissions (such as SO_2) that can lead to potential acidification of ecosystems.

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{EPRI Comments on Proposed HAPs MACT Rule
4 August 2011}
[Page 3-22]

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3.5 EPRI's comprehensive sector-wide inhalation risk assessment on all 470 coal-fired generating facilities identified no cancer or non-cancer health risks above regulatory risk threshold, in contrast to EPA's 16 case studies assessment

In 2008, EPRI initiated a comprehensive evaluation of HAPs emissions and potential inhalation risks attributable to those emissions from coal-fired electric utilities, based on updated sector-wide data for all units with capacity greater than 25 MW [EPRI, 2009]. As part of this research, EPRI

prepared revised emission estimates for the entire, current coal-fired fleet (as of base case year 2007) to combine with stack air dispersion modeling for derivation of health risk estimates for each unit. Emissions estimates for mercury and non-mercury HAPs (e.g., trace elements, acid gases, and select organic compounds) were derived through a series of steps reported in EPRI [2009] and summarized below:

- Developed HAPs and mercury concentration datasets for coals categorized by coal source and geography (county/state/coal region).

- Developed coal type specific consumption rates for each EGU, including those units burning coal blends, using publically available fuel data.

- Obtained individual power plant parameters for 2007 base year operations (e.g., control technologies, physical configurations, stack particulate emission rate, stack parameters, etc.).

- Updated existing emission correlations and emission factors.

As detailed in the EPRI report [2009], these updated correlations, HAP-specific emission factors, plant configuration parameters, and fuel consumption data (including blended coal composition data) were used to estimate annual emissions (mass/year basis) for each power plant unit. These annual emissions estimates (e.g., lb/TBtu in 2007) served as specific input for the tiered inhalation health risk assessment conducted by EPRI and AECOM in 2008–2009.

EPRI and AECOM followed guidance from EPA's Office of Air Quality Planning and Standards (OAQPS) in designing the study's tiered approach, based primarily on guidelines published in EPA's Air Toxics Risk Assessment Reference Library [EPA, 2004] with additional input from OAQPS staff. In summary, the tiered approach evaluated chronic non-cancer, acute non-cancer, and cancer risk for a comprehensive group of HAPs in the following three scenarios:

- **Tier 1:** Screening level inhalation risk assessment on all 470 coal-fired U.S. generating facilities with a total of 825 stacks (base year 2007) using EPA's SCREEN3 model which is based on ISCST3 dispersion algorithms and applies a generic set of meteorological conditions.

[Page 3-23]

- **Tier 2:** Inhalation risk assessment using the EPA Human Exposure Model (HEM3- AERMOD) for a subset of 198 power plants identified as highest risk in Tier 1.

- **Risk evaluation for facilities having stacks located within 50 km of one another:** Two-level analysis of 100 facility groups (consisting of two to 10 power plants) with the potential for overlapping plumes.

Summary results for the 470 individual coal-fired power plants included the following:

- Comparison of the overall Tier 1 modeling to the more-refined Tier 2 modeling indicated that Tier 2 risk was substantially lower—10% of

corresponding Tier 1 risk. Even at the 95% percentile level, Tier 2 risk was only 24.1% of the corresponding Tier 1 risk.

- No individual power plant assessment resulted in a modeled health risk exceeding the EPA recommended thresholds: non-cancer hazard quotient (HQ) > 1, or cancer risk greater than 1 x 10^{-6} (1 in a million).

- The 10 facilities with the highest cancer risk had values ranging from 7.14 x 10^{-7} to 9.78 x 10^{-7}, with all values below the 1 x 10^{-6} threshold.

- The 10 facilities with the highest chronic non-cancer risk had values ranging from HQ 0.284 to 0.668, with all values below the HQ > 1 threshold.

- The 10 facilities with the highest acute non-cancer risk had values ranging from HQ 0.119 to 0.295, with all below the HQ > 1 threshold.

- The primary chemical drivers of cancer risk were arsenic (average of 76%) and hexavalent chromium (17%), with minor contributions from other trace metals (7%).

- The primary chemical drivers of the chronic non-cancer risk were chlorine (average of 97%) and hydrogen chloride (1%).

- The primary chemical drivers of the acute non-cancer risk were arsenic (average of 52%) and acrolein (9%), with additional contributions from hydrogen chloride, chlorine, and hydrogen fluoride.

Summary results for the two-level assessment of the 100 facility groups with potentially overlapping plumes included the following:

- The screening assessment, using simple addition of component facility maximum risk, identified 22 facility groups for refined analysis.

- Further analysis of these 22 facility groups—based on refined HEM3-AERMOD modeling with risks summed across the group on a receptor-by-receptor basis—identified two groups of facilities with potentially overlapping plume domains that could result in risks above the cancer threshold.

- The refined, combined cancer risk for the 22 facility groups ranged from 3.95×10^{-7} to 1.21×10^{-6}.

- The two highest facility groups marginally approached the 1×10^{-6} cancer risk threshold—four facilities on the Illinois/Indiana border at 1.03×10^{-6} and five facilities on the Ohio/Pennsylvania border at 1.21×10^{-6}.

[Page 3-24]

- Given the conservative aspects of this analysis, such as the presumed 70-year lifetime exposure at a fixed outdoor location, the actual inhalation risks are likely to be well below the significance level.

In summary, a comprehensive tiered inhalation risk assessment using EPA-prescribed methods with improved emission factors, fuel data, and confirmed stack parameters did not identify significant health

risks (cancer or non-cancer) among U.S. coal-fired power plants (as they existed in 2007). These results contrast with those presented by EPA for its non-mercury case studies on 16 (15 coal-fired) power plants [EPA, 2011]. As further described in EPRI Comments, Section 3.6, several issues appear to underlie these differences, indicating the need for EPA to re-evaluate its assessment and to undertake a Tier 3 risk assessment for any facility of concern.

In a Tier 3 multi-pathway risk assessment using EPA-prescribed methods along with improved data and analytical functionality, EPRI [EPRI, 2011] found no significant health or ecological risks for aquatic or terrestrial receptors from mercury and arsenic emissions at a modeled coal-fired generating facility. Appendix J presents a summary of this multi-pathway risk study.

3.5.1 References

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EPRI, 2011. "Multi-Pathway Human Health and Ecological Risk Assessment for a Model Coal-Fired Power Plant." AECOM Report to Electric Power Research Institute (EPRI), Palo Alto, CA. August.

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Strum M., Thurman J., Morris M., 2011. MEMORANDUM to Docket EPA-HQ-OARL-2009-0234, "Non-Hg Case Study Chronic Inhalation Risk Assessment for the Utility MACT Appropriate and Necessary Analysis," March 16.

3.6 EPA's 16 case studies for inhalation risk assessment need to be re-evaluated due to erroneous data that affect EPA's final risk numbers

3.6.1 Summary of EPA's risk assessment

To support its appropriate and necessary analysis of coal- and oil-fired EGUs, EPA evaluated the maximum lifetime chronic inhalation risk for cancer and non-cancer health outcomes from utility emissions of HAPs other than mercury. The Agency selected several facilities as Chronic Inhalation Risk Assessment (CIRA) case studies, and documented the methods and results of these case studies in Strum, et al. [2011].

Before ICR [EPA, 2009] emissions data were available, EPA selected an initial set of eight case study facilities. [3] These facilities had the highest estimated cancer and non-cancer risks, based on

[Page 3-25]
the 2005 National Emissions Inventory (NEI) data analyzed using HEM-3. For these facilities, EPA

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[3] Xcel Bayfront, SC&E Canadys, Dominion Chesapeake Energy Center, Exelon Cromby Generating Station, Spruance Genco, PSI Energy–Wabash River, HECO Waiau, and Dominion–Yorktown

reported that nickel (Ni), hexavalent chromium (Cr+6), and arsenic (As) were the cancer risk drivers; non-cancer risks, such as those from hydrogen chloride, were not significant.

After ICR emissions data became available, EPA selected eight additional case study facilities, [4] based on magnitude of emissions, heat input values (throughput), and level of emission control. Thus, the full set of case studies included 16 facilities, all selected for elevated risk potential.

To calculate chronic inhalation exposure to emissions from these 16 case study facilities, EPA first computed "actual" emissions and "potential" emissions [5] on an EGU unit-by-unit basis. Then the Agency modeled emissions dispersion using AERMOD. In this exercise, each boiler or combination of boilers at a facility was modeled as an individual emission point, and census block centroids within 20 km of each facility were used as model receptors. Inputs to AERMOD include 5 years of meteorological data, as well as 1992 land cover data used to calculate surface characteristics at the meteorological station sites.

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[4] Cambria Cogen, Conesville, TVA Gallatin, City Utilities of Springfield–James River, Ameren–Labadie, PSNH–Merrimack, Monticello Steam Electric Plant, and OG&E–Muskogee.

[5] "Actual" emissions were developed directly from actual test data; "potential" emissions were developed when actual test data were not available for facilities/units. Emission factors for these units were calculated from similarly configured units at the facility (site-average across tested units) or from similarly configured units from other facilities tested (average across tested units with similar configuration).

For the risk assessment for chronic inhalation exposures, EPA first estimated 5-year average HAPs ambient concentrations at census block centroids from the dispersion modeling. The estimated concentration at a census block centroid then became a surrogate for the concentration to which all people residing in that census block were chronically exposed. Then, maximum individual cancer risk (MIR) for each facility was calculated. [6]

For its "actual" emissions case, EPA's analysis estimated the highest lifetime inhalation cancer risk from any of the 16 case study facilities was from Hawaiian Electric Company (HECO) Waiau, an oil-fired facility where a greater than 1 in a million risk (1.0×10^{-5}) was driven by nickel emissions. EPA calculated that three coal-fired case study facilities had maximum cancer risks greater than 1 in a million: City Utilities of Springfield–James River (8.0×10^{-6}); Dominion Chesapeake Energy Center (3.0×10^{-6}); and Conesville (3.0×10^{-6}). EPA's calculations determined that risks at these coal-fired facilities were driven by hexavalent chromium emissions. It is important to note that a screening level inhalation cancer risk of greater than 1 in a million indicates the need for more detailed study of the factors contributing to risk at those facilities.

All 16 of the case study facilities had non-cancer target-organ-specific hazard index (TOSHI) values of

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[6] A risk due to a continuous exposure to the maximum concentration that equals 24 hours per day, 7 days per week, and 52 weeks per year for a 70-year period at the centroid of an inhabited census block.

less than one, with a maximum TOSHI value of 0.4 at oil-fired HECO Waiau.

In examining EPA's chronic inhalation risk assessment for the 16 case study facilities, EPRI has identified several critical issues, related to the underlying data, where flaws need to be addressed. As described below, these issues involve stack parameters, stack concentrations, emission rates, and maximum lifetime exposures.

[Page 3-26]

3.6.2 Several stack parameters, stack concentrations, and emission rates used by EPA are flawed and in some cases erroneous

A review of stack parameters, stack concentrations, and emissions rates conducted by EPRI indicates that corrections to EPA emission estimates for arsenic, chromium, and nickel are warranted. EPRI reviewed the supporting information file provided by EPA ("Casestudy_emis_26apr2011 for EPRI.xls," called the "EPA case study spreadsheet" in these Comments) to evaluate EPA's methodology for estimating emissions from those case study facilities where EPA estimated a lifetime cancer risk at or greater than 1 in a million. EPA did not provide data for case study facilities where the Agency estimated a lifetime cancer risk at less than 1 in a million.

For EGUs tested in the 2010 ICR, EPA appears to have used the reported Part III emission test data to develop annual emissions estimates for use in its case study risk evaluation. For EGUs not tested as part of the ICR, EPA used (a) data from a sister EGU that was tested, or (b) an average emission factor

(EF) derived from ICR-tested EGUs grouped by type of control system (e.g., ESP, fabric filter, ESP/wet FGD, etc.). EPA did not apply the proper statistical methodology for lognormally distributed data sets when employing an arithmetic mean for the emissions data from each control class bin; the geometric mean should be used.

EPRI's review of EPA's supporting information indicates that several of the coal-fired case study facilities with an EPA-calculated cancer risk of greater than 1 in a million have chromium as the primary risk driver (Appendix E, Table E-1). This is contrary to previous health risk modeling results [EPRI, 2009] that did not show chromium as the primary cancer risk driver for any coal-fired EGU of greater than 25 MW capacity. Therefore, EPRI performed a more detailed evaluation of the chromium emissions data obtained from the ICR test sites. This evaluation is presented in Appendix E.

EPRI also found several errors in the stack parameters (e.g., number of stacks, stack flow, velocity) used by EPA for several case study EGUs. These errors would likely have implications for calculated emissions, as well as for the overall risk assessment.

The following discussion highlights the results of EPRI's data quality assurance/quality control (QA/QC) review.

- **Seven EGUs have significantly elevated chromium concentrations and consequently, anomalous emission factors:** EPRI's review of the individual run data in EPA's data set found

seven EGUs with elevated concentrations of chromium, arsenic, nickel, and sometimes manganese (Mn) (see Appendix E for further details). The average chromium concentration from these suspect runs was more than an order of magnitude higher than the average chromium concentration obtained in all the other runs.[7] Thus, two EGUs (Conesville Unit 3, James River Unit 5) had chromium EFs that were statistically significant outliers or extreme values (in this case, defined as the average of the EF data set plus three standard deviations, $p < 0.0001$). Moreover, in some cases the amount of chromium measured at the stack was greater than the amount entering with the coal (e.g., James River Unit 5, Gallatin Unit 2).

[Page 3-27]

This suggests potential metallic contamination in one or more runs, and data from these seven EGUs should be excluded from any risk analysis.

- **Emission factors are not appropriately calculated:** EPRI's review of the ICR data (Bin 1– ESP only) indicates that the data are clearly not normally distributed based on EPA's own guidelines. Thus, the use of an arithmetic mean is not appropriate, and the use of a geometric mean is more appropriate for a lognormal distribution.

- **Emission factors are not differentiated by coal rank:** For case study facilities not tested in

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[7] EPA's average Cr emission factor for the Phase II "1-ESP" bin was 5.62E-5 lb/MMBtu. If the 7 EGUs with suspected contamination are excluded, the average is 6.2E-6 lb/MMBtu.

the ICR, the EPA case study spreadsheet provides an assignment to a specific coal rank and control class. However, for case study facilities with ESPs not tested in the ICR, EPA apparently used a single average EF that is not differentiated by coal rank.

- **The difference between the "Phase I" and "Phase II" and derivation of emission factors is not clear:** Further explanation from EPA is needed to clarify what is meant by "Phase I" and "Phase II" EF derivation.

- **ICR test EGUs were omitted from the "1-ESP" bin used by EPA to calculate the Phase II average emission factors:** Sunbury, boiler 4, a coal-fired unit with ESP controls, should be included in the "1-ESP" bin calculations. EPA should check the ICR data set to be sure all test units have been properly assigned to a control class bin for the emission factor calculations.

- **Several stack parameters used by EPA are erroneous:** EPRI found that several of the stack parameters used by EPA are incorrect. This conclusion is based on consultation with the facilities listed in the EPA case study spreadsheet, and on EPRI's 2007 data [EPRI, 2009]. Appendix F, Table F-1 lists all the case study EGUs, EPA's stack parameters, and EPRI's correct stack parameters. EPA needs to incorporate these correct stack parameters in a re-assessment of the non-mercury chronic inhalation risks from the selected case study facilities.

[Page 3-46]
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3.16 Utility acid gas emissions, which are predominantly HCl, are insignificant contributors to acidification of ecosystems in the United States

These comments pertain to III.D. (4); 76 *Federal Register*, No. 85, May 3, 2011 p. 25013 and p. 25050.

EPA states that the deposition of hydrochloric acid (HCl) would further exacerbate the impacts of acidifying deposition from sulfur and nitrogen compounds. The extent to which acidifying deposition from sulfur and nitrogen compounds affect ecosystems is difficult to assess, as evidenced in the recent notice of proposed rulemaking for revision of the Secondary NAAQS of NO_x and SOx [76 *Federal Register*, No. 147, August 1, 2011 pp. 46084-46147]. Notwithstanding the uncertainties in the effects from sulfur and nitrogen compounds, the impact of acid gas emissions, such as hydrochloric acid, are insignificant. In fact, the only citation in support of EPA's statement of concern over HCl emissions is a recent manuscript [Evans et al., 2011] that does not reflect conditions relevant to the United States.

The work of Evans, et al. [2011] on the environmental effects of HCl deposition on acidification ofwaterbodies contained within peatlands in the United Kingdom (U.K.) serves as the basis for EPA's discussion of the potential environmental impacts of HCl deposition in the proposed

[Page 3-47]
MACT rule. However, the Evans, et al. study is an inappropriate study to apply to the United States for three primary reasons:

1. U.S. coals have substantially lower chlorine (Cl) content than U.K. coals.

2. U.S. soils are predominantly of different composition than the peatland U.K. soils discussed in Evans, et al.; i.e., the United States has very limited geographical extent of histosols, which are organic soils including peatlands, bogs, moors, and mucks.

3. The extent of chloride (Cl^- mobility observed by Evans, et al. cannot be generalized to all ecosystems.

Additionally, there is no evidence to suggest that HCl should be of concern in the United States with respect to environmental acidification. The main reasons are as follows:

- Emissions of HCl from power plants, and HCl emissions overall in the United States, are negligible, amounting to less than 0.7% of emissions with an acidifying potential (on a molar equivalent or charge equivalent basis).

- Anthropogenic SOx and HCl emissions have been reduced (oh a relative, i.e. percentage, basis) by similar amounts from 1998 to 2009. Although a clear decrease in sulfate deposition has been observed by the National Atmospheric Deposition Program (NADP), there has been no signal of decreased HCl deposition over the United States; thereby making any contribution from anthropogemc HCl emissions negligible compared to the background contribution.

These and other factors combine to demonstrate that HCl emissions from power plants are negligible contributors to ecosystem acidification in the United States. Accordingly, HCl emissions have not been the focus of past U.S. assessments of acidification. To the extent that chloride deposition has been included in ,such assessments, it has been to include the contribution from sea-salt aerosol and background HCllevels for completeness.

3.16.1 Summary of Evans, et al. [2011] research

The Evans, et al. analysis, titled "Hydrochloric Acid: An Overlooked Driver of Environmental Change," primarily investigated trends in the chemical composition of

- wet deposition samples (26 sites in the U.K. Acid Deposition Monitoring Network, two-week sampling period) from 1986- 2007,

- surface water samples (22 sites in the U.K. Acid Waters Monitoring Network) from 1988-2007,and

- soil samples (3 sites in the Environmental Change Network) from 1993-2007.

The deposition samples were analyzed for the non-marine components of chloride (Cl^- and sulfate (SO_4^{2-}) by subtracting out the seasalt Cl^- and SO_4^{2-} based on ratios to sodium (Na^+). The main source of non-marine chloride is HCl emissions from coal combustion in EGUs. Results were grouped by zones defined previously by non-marine sulfate deposition that are stated to represent more or less contribution from major industrial emission sources. The surface water and soil samples were intended to provide additional trend information, but the authors explain that neither could be used to reliably separate marine from non-marine Cl^- or SO_4^{2-}. In

[Page 3-48]
particular, the soil samples were solely from histosols, i.e., heavily organic soils, including peatlands, moors, and bog lands. The manuscript provides the trends in non-marine Cl^- which, despite substantial interannual variability, decreased in wet deposition samples at every site. Larger decreases were observed at sites with the highest initial non-marine Cl^- concentrations. Larger decreases were observed in geographic zones thought to be most influenced by industrial emissions. Non-marine sulfate followed generally similar temporal and spatial patterns. Previously reported changes in nitrogen deposition could not account for the observed soil and water trends. The authors suggest that these trends are consistent with the 95% reduction in HCl emissions from power plants over the past 20 years. The trends in total Cl^- (separated

into non-marine Cl^-) in surface waters were similar to, or exceeded those in rainfall non-marine Cl^-, and also were largest in the zone most influenced by industrial emissions. Similarly, decreases in total Cl^- and SO_4^{2-} were observed at the three soil sites. At one peat soil site, sulfate and nitrate had remained constant since the early 1990s due to complete retention in soils. The authors state " ... despite the capacity of peats to retain most or all pollutant SO_4^{2-} and NO_3^- [nitrate]... " the waters did acidify and are now recovering. The authors conclude the concurrent increase in pH l).t that site is due to the observed reduction in soil Cl^- This would require that chloride was not retained in soils, but rather that Cl^- "mobility" and related persistence led to acidification. In summary, the authors suggest that 30-40% of the acideification recovery in the United Kingdom since the: 1980s could have resulted from heretofore unconsidered changes in HCl, and not solely changes in sulfate.

3.16.2 Detailed comments on the use of Evans, et al. regarding U.S. ecosystem acidification

The proposed rule states that

> "EPA is also concerned about the potential impacts of HCl and other acid gas emissions on the environment. When HCl gas encounters water in the atmosphere, it forms an acidic solution of hydrochloric acid. In areas where the deposition of acids derived from emissions of sulfer and NO_x are causing aquatic and/or terrestrial acidification, with accompanying ecological impacts, the deposition of hydrochloric acid would further

> exacerbate these impacts. Recent research [Evans et al., 2011] has, in fact, determined that deposition of airborne HCl has had a greater impact on ecosystem acidification than anyone had previously thought, although direct quantification of these impacts remains an uncertain process." (III.D. (4); 76 FR, May 3, 2011 p. 25013)

The Evans, et al. manuscript is cited as supporting evidence for the ecosystem acidification impacts of HCl emitted from power plants in the proposed rule (e.g., 76 FR, May 3, 2011 p. 25013 and p. 25050). However, it is inappropriate to apply these results in such a manner because they are not representative for use in U.S. ecosystems. Additionally, when U.S. appropriate data is investigated, there is no evidence to suggest that HCl is a concern for environmental acidification under U.S. conditions.

The analysis of U.K. ecosystems is inapplicable to the United States for three reasons.

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[Page 3-53] **Table 3-5 HCl Emissions Relative to Other Emissions of Concern with Respect to Acidification in the United States (1998-2004)**

Source Category	1998	1999	2000	2001	2002	2003	2004
EGU HCl (lb)	552,351,661	613,519,349	598,486,701	526,866,196	545,864,039	548,297,900	503,112,944
ALL HCl (lb)	611,028,506	669,284,107	655,525,933	582,182,096	601,363,861	602,002,655	554,859,166
EGU SO2 kton	13,416	12,583	11,396	10,850	10,436	10,425	10,415
EGU NOx kton	6,232	5,721	5,330	4,917	4,709	4,404	4,098
EGU NH3 kton	8	11	11	11	29	28	27
EGU HCl kton	276	307	299	263	273	274	252
ALL SO2 kton	18,943	17,544	16,348	15,932	14,774	14,797	14,820
ALL NOx kton	24,347	22,843	22,599	21,546	21,135	20,464	19,793
ALL NH3 kton	4,940	4,857	4,907	3,689	4,133	4,136	4,138
All HCl kton	306	335	328	291	301	301	277
EGU SO2 Geq	380	356	323	307	296	295	295
EGU NOx Geq	123	113	105	97	93	87	81
EGU NH3 Geq	0	1	1	1	2	1	1
EGU HCl Geq	7	8	7	7	7	7	6

kton =thousand US short tons, can also be writien as 000 ton, thousand ton, or 10^3 ton
Geq = giga equivalents, can also be written as 000 000 000 eq, billion eq, or 10^9 eq

Table 8-5 (continued) HCl Emissions Relative to Other Emissions of Concern with Respect to Acidification in the United States (1998- 2004

Source Category	1998	1999	2000	2001	2002	2003	2004
ALL 502 Geq	536	497	463	451	418	419	420
ALL NOx Geq	480	450	446	425	417	404	390
ALL NH3 Geq	263	259	261	197	220	220	220
ALL HCl Geq	8	8	8	7	7	7	7
EGU (802 + NH3 + NOx) Geq	510	477	436	411	397	390	383
ALL (SO2 + NH3 + NOx) Geq	**1,287**	**1,214**	**1,178**	**1,080**	**1,063**	**1,050**	**1,037**
EGU HCl/(SO2 + NH3 + NOx) eq ratio	1.3%	1.6%	1.7%	1.6%	1.7%	1.7%	1.6%
ALL HCl/(SO2 + NH3 + NOx) eq ratio	**0.6%**	**0.7%**	**0.7%**	**0.7%**	**0.7%**	**0.7%**	**0.7%**

Sources:
1998-2008 dala: Adapted from http:liwww.epa.gov/ttn/chief/trends/; 2008 NH3 emissions from EGU and all sources estimated by equating to 2007 EPA has yet to post 2008 NH3 emissions on the cited webpage.

2009 data: EGU data is generated from htlp://camddataandmaps.epa.gov/gdm/index.clm ; 2009 data for all sources only takes into account decreases in EGU emissions relative to 2008, i.e., all other emissions are kept at 2008 levels.

eq =the amount of a substance that wi ll either react with or supply one mole of hydrogen ions (H+) in an acid-base reaction, or react with or supply one mole of electrons in a redox reaction

eq ratio = ratio of two quantities based on molar equivalents (calculated by dividing the mass by the "equivalent weight," also known as the "gram equivalent weight," or "gram equivalent mass")

[Page 3-55]
Table 3-6

HCl Emissions Relative to Other Emissions of Concern with Respect to Acidification in the United States (2005-2009)

Source Category	2005	2006	2007	2008	2009	2009/1998	1-(2009/1998)
EGU HCl (lb)	514,179,917	477,148,324	453,009,35	356,141,930	241,578,891	44%	56%
ALL HCl (lb)	565,802,886	528,771,572	503,4C8,903	403,675,608	279,941,875	46%	54%
EGU SO2 kton	10,404	9,404	8,941	7,552	5,816	43%	57%
EGU NOx kton	3,792	3,446	3,320	3,006	2,066	33%	67%
EGU NH3 kton	27	29	32	32	32	400%	-300%
EGU HCl kton	257	239	227	178	121	44%	56%
ALL SO2 kton	**14,844**	**13,655**	**13,006**	**11,429**	**9,693**	**51%**	**49%**
ALL NOx kton	**19,122**	**18,110**	**17,321**	**16,339**	**15,399**	**63%**	**37%**
ALL NH3 kton	**4,143**	**4,135**	**4,131**	**4,131**	**4,131**	**84%**	**16%**
All HCl kton	**283**	**264**	**252**	**202**	**140**	**46%**	**54%**
EGU SO2 Geq	295	266	253	214	165	43%	57%
EGU NOx Geq	75	68	65	59	41	33%	67%
EGU NH3 Geq	1	2	2	2	2	400%	-300%
EGU HCl Geq	6	6	6	4	3	44%	56%

[Page 3-56]
Table 3-6 (continued)
HCl Emissions Relative to Other Emissions of Concern with Respect to Acidification in the United States (2005-2009)

Source Category	2005	2006	2007	2008	2009	2009/1998	1-(2009/1998)
ALL SO2 Geq	420	387	358	324	275	51%	49%
ALL NOx Geq	377	357	342	322	3044	63%	37%
ALL NH3 Geq	221	220	220	220	220	84%	16%
ALL HCl Geq	7	7	6	5	3	46%	54%
EGU (SO2 + NH3 + NOx) Geq	377	342	326	279	210	41%	59%
ALL (SO2 + NH3 + NOx) Geq	1,025	971	936	871	802	62%	38%
EGU HCl/(SO2 + NH3 + NOx) eq ratio	1.7%	1.7%	1.7%	1.6%	1.4%		
ALL HCl/(SO2 + NH3 + NOx) eq ratio	0.7%	0.7%	0.7%	0.6%	0.4%		

Estimate
Sources
1998-2008 data: Adapted from http://www.epa.gov/ttn/chiefltrends/ ; 2008 NH3 emissions from EGU and all sources estimated by equating to 2007 EPA has yet to post 2008 NH3 emissions on the cited webpage.
2009 data: EGU data is generated from http://camddataandmaps.epa.gov/gdm/index.cfm ; 2009 data for all sources only takes into account decreases in EGU emiss ions relative to 2008, i.e., all other emissions are kept at 2008 levels.

423

Part 1 of 3

COMMENTS OF EXELON CORPORATION ON U.S. ENVIRONMENTAL PROTECTION AGENCY'S PROPOSED NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FROM COAL- AND OILFIRED ELECTRIC UTILITY STEAM GENERATING UNITS AND STANDARDS OF PERFORMANCE FOR FOSSIL-FUEL-FIRED ELECTRIC UTILITY, INDUSTRIALCOMMERCIAL-INSTITUTIONAL, AND SMALL INDUSTRIALCOMMERCIAL-INSTITUTIONAL STEAM GENERATING UNITS

Docket ID No. EPA-HQ-OAR-2009-0234 and
Docket ID No. EPA-HQ-OAR-2011-0044
76 Fed. Reg. 24,976 (May 3, 2011)

Comments
Appendices
Exhibits 1 - 9

August 4, 2011

* * *

[Page 6]

COMMENTS

1. THE TOXICS RULE PROVIDES MUCH NEEDED REGULATORY CERTAINTY, AND COMPLIANCE CAN BE ACHIEVED WITHIN THE THREE-YEAR TIME PERIOD MANDATED BY SECTION 112, WITH APPROPRIATE SAFEGUARDS FOR EXTENSIONS IN LIMITED CIRCUMSTANCES.

1.1 The Toxics Rule Will Provide Needed Regulatory Certainty And Will Spur Investment In New Generation.

By any measure, the regulatory certainty provided by the Toxics Rule is long overdue. Contrary to the overblown critiques by some, much of the industry anticipated the proposed Rule and supports prompt action to finalize the Rule. Currently, MACT emission limitations are inconsistently determined by permitting agencies on a case-by-case basis.[1] The resulting hodgepodge of

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[1] Without the Toxics Rule, existing major sources in any state with a Title V permit program that modernize and undergo a "modification" and any new or reconstructed sources are subject to case-by-case MACT emission limitations under section 112(g)(2) for all HAPs they emit. See 42 U.S.C. § 7412(g)(2)(A), (B) (prohibiting modifications to existing major sources and construction or reconstruction of new major sources without MACT emission limitations). *See, e.g., Southern Alliance for Clean Energy v. Duke Energy Carolinas, LLC*, 2008 WL 5110894, No. 1:08-cv-318 (W.D.N.C. Dec. 2, 2008), in which the court granted summary judgment to the plaintiffs and confirmed that a new EGU, for which Duke Energy had

standards creates enormous uncertainty for existing EGU owners.

Moreover, the lack of a national standard for toxic emissions continues to be a barrier to investment in new, cleaner generation capacity as well as the modernization of existing sources. Companies are reluctant to build replacement, cleaner generation or to modernize existing plants when it is not assured that their competitors will be required to comply with modern emission standards. Unit owners that modernize plants and install controls often are punished in markets where generation is dispatched according to cost. EGUs operating without pollution controls have lower operating costs than equivalent EGUs with controls and can, therefore, underbid the plants with controls in electricity markets. Therefore, all things being equal, a plant without pollution controls will be dispatched before a plant that is operating with pollution controls.[2] This dynamic perversely punishes unit owners that installed controls and

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received an air quality permit from the North Carolina Division of Air Quality 10 days prior to the decision in *New Jersey v. EPA* vacating EPA's de-listing of EGUs, was subject to a MACT determination for new sources under section 112(g)(2)(B).

[2] In competitive wholesale markets, energy prices are set by marginal units operating at, or close to, their marginal costs. The independent market monitors have consistently found that energy prices do in fact reflect the marginal costs of production. The installation of pollution controls will raise the marginal costs of production for those early adopters and place them at a competitive disadvantage relative to those that do not install pollution controls.

[Page 7]
provides an economic incentive to increase the operation of the least controlled, most polluting units.

The nation's utility industry already has lost nearly a decade of planning and investment time between 2004, when the Clean Air Mercury Rule was proposed in lieu of a MACT standard, and 2015, when the Toxics Rule will require compliance. Today we increasingly rely on aged infrastructure that operates without pollution controls simply because the federal government has failed to establish legally enforceable emissions standards for toxic pollutants.

The lack of regulatory certainty impacts not only the fossil fleet, but also the development of the nation's nuclear, hydro, wind, solar and other important resources. Exelon has announced nearly $5 billion in low emission generation investments and energy efficiency projects, the majority of which have not yet occurred and hinge on the economic transition of older generation to new and cleaner resources.[3] These investments would be jeopardized or forestalled if EPA fails to act or further across-the-board delay occurs. And, Exelon is far from alone. A study by the University of Massachusetts Political

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[3] *See* Exelon News Release, "Exelon Plans Nearly $5 Billion Investment in Affordable Clean Energy Projects to Advance Low-Carbon Roadmap" (Nov. 16, 2010) ("Exelon News Release", attached hereto as Exhibit 1). These projects include energy-efficiency and smart grid programs, economic renewable energy investments, and increased output at Exelon's nuclear plants achieved through Exelon's nuclear uprate program, all of which will produce clean power with no GHG emissions or emissions of conventional or hazardous air pollutants.

Economy Research Institute found that EPA's new air rules will trigger over $100 billion in investment in new generation capacity in the Eastern Interconnection by 2015.[4] This investment in modernization is desperately needed. In 2007-2008, 59% of the nation's coal-fired units, and 34% of the coal generation capacity, were over 40 years old.[5] Americans and the utility industry deserve regulatory certainty to plan for the replacement of this generation. Delay and inaction are not options.

[Page 8]

1.2 Three Years Is Sufficient Time For Electric Generators To Come Into Compliance With The Toxics Rule.

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[4] *See* James Heintz, Heidi Garrett-Peltier, Ben Zipperer, "New Jobs Cleaner Air – Employment Effects Under Planned Changes to the EPA's Air Pollution Rules," at 2 (University of Massachusetts Political Economy Research Institute) (Feb. 2011) (citing Ira Shavel & Barclay Gibbs, Charles River Associates, "A Reliability Assessment of EPA's Proposed Transport Rule and Forthcoming Utility MACT" (Dec. 16, 2010)) ("PERI Report"), *available at* http://www.ceres.org/resources/reports/new-jobs-cleanerair. The PERI Report, based on a report by Charles River Associates, indicates that the rules would trigger almost $200 billion in investment, with $94 billion in new pollution controls and over $100 billion in new generation capacity. The PERI Report found that these investments would create 1,457,885 direct and indirect jobs (in "job years") between 2010 and 2015, without counting induced jobs.

[5] Michael J. Bradley, Christopher E. Van Atten, Amlan Saha, & Carrie Jenks (M.J. Bradley & Associates LLC) & Susan F. Tierney & Paul J. Hibbard (Analysis Group), "Ensuring a Clean, Modern Electric Generating Fleet while Maintaining Electric System Reliability" at 20 (August 2010) ("M.J. Bradley Report", attached hereto as Exhibit 2).

For more than a decade the electricity industry has been aware that EPA will establish HAP emissions limitations for EGUs. Prudent EGU owners have used that time to prepare, and have already evaluated how to meet potential emission limitations. Indeed, announcements since the proposal of the Toxics Rule have demonstrated that utilities that act promptly will be able to meet the Toxics Rule compliance deadlines. In recent months, Ameren Energy Generating Co. and Detroit Edison separately entered into contracts for the installation of four flue gas desulfurization ("FGD") systems at plants in Illinois and Michigan, with scheduled completion dates between November 2013 and December 2014.[6] SEC filings show that companies have been well aware of the impending requirements of the Toxics Rule and many prudent companies have already planned for regulations. The comments from these investor owned electric utilities, attached as Appendix A, paint a picture of confidence in their ability to adapt to the Toxics Rule.[7] Indeed, Southern

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[6] McIlvaine Co., "FGD and DeNox Newsletter," June 2011, No. 398 (attached hereto as Exhibit 3).

[7] *See, e.g.*, Ameren Corporation, Annual Report (Form 10-K), at 32 (Feb. 24, 2011) ("Ameren is continually evaluating these changing environmental standards for the impact on its power plants and is focused on meeting these requirements in the most cost effective manner possible."); NRG Energy Inc., Annual Report (Form 10-K), at 27 (Feb. 22, 2011) ("NRG believes it is positioned to meet more stringent requirements through its planned capital expenditures, existing controls, and the use of Powder River Basin coal."); The Southern Company, Annual Report (Form 10-K), at II-25 (Feb. 25, 2010) ("The Company has developed and continually updates a comprehensive environmental compliance strategy to assess compliance obligations associated with the continuing and new

Company, one of the companies that most vociferously attacks the Toxics Rule as an industry-wide cataclysm, speaks soothingly to its investors in SEC filings that it will comply with the Rule and continue to be profitable.[8]

[Page 9]

Experts and companies that specialize in the installation of emission control technologies likewise have concluded that controls can be installed within

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environmental requirements discussed above. As part of this strategy, the Company has already installed a number of SO_2 and NO_x emissions controls and plans to install additional controls within the next several years to ensure continued compliance with applicable air quality requirements."). Relevant excerpts from SEC filings of investor owned electric utilities have been included in Appendix A.

[8] For example, Southern Company represented in its most recent Annual Report filed with the SEC that "[a]dditional controls are currently planned or under construction to further reduce air emissions, maintain compliance with existing regulations, and meet new requirements." Southern Company, Annual Report (Form 10-K), at II-23 (Feb. 25, 2011). After discussing the Toxics Rule that was then being developed, the Company stated: "As part of [its] strategy, the Company has already installed a number of SO_2 and NO_x emissions controls to ensure continued compliance with applicable air quality requirements." *Id.* at II-25. Southern Company then turned about face and testified before the Subcommittee on Energy and Power that "industry experience demonstrates conclusively that achieving compliance on EPA's three-year timeline is unachievable." *See* Hearing Before the Subcomm. on Energy and Power of the H. Comm. on Energy and Commerce, 112th Cong. (April 15, 2011) (testimony of Thomas A. Fanning, Chairman, President and Chief Executive Officer, Southern Company).

the statutory threeyear period.[9] In its April 2011 report entitled "Assessment of Technology Options Available to Achieve Reductions of Hazardous Air Pollutants" (Exhibit 7), URS Corporation catalogues available technologies and considers how existing facilities with a variety of technology configurations might upgrade to meet the Toxics Rule.[10] URS concludes not only that technology is readily available, but that the technology most likely to be selected by existing facilities can typically be installed in less than two years, let alone three.[11]

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[9] *See, e.g.*, James E. Staudt (Andover Technology Partners) & M.J. Bradley & Associates LLC, "Control Technologies to Reduce Conventional and Hazardous Air Pollutants From Coal-Fired Power Plants," prepared for Northeast States for Coordinated Air Use Management ("NESCAUM"), at 26-27 (March 31, 2011) ("NESCAUM Report", attached hereto as Exhibit 4). Indeed, NESCAUM submitted comments when the Clean Air Mercury Rule was proposed in 2004 confirming that technology was then available to achieve a 90% reduction in mercury emissions, a reduction commensurate with that called for in the Toxics Rule. *See* NESCAUM, Comments to Docket Number OAR- 2002-0056 on: "Proposed National Emission Standards for Hazardous Air Pollutants; and in the Alternative Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 69 Fed. Reg. 4652," at 2-3, 9 (June 29, 2004) ("NESCAUM Comments on Finding Revision", attached hereto as Exhibit 5). *See also*, Praveen Amar, William O'Sullivan, & John Paul, "State and Local Air Pollution Control Officials Recommendations for Utility MACT Standards" (Oct. 22, 2002) ("State and Local Air Pollution Control Officials Recommendations", attached hereto as Exhibit 6).

[10] George Lipinski, Jean Leonard, & Carl Richardson, URS, "Assessment of Technology Options Available to Achieve Reductions of Hazardous Air Pollutants," at 3 (April 5, 2011) ("URS Technology Assessment", attached hereto as Exhibit 7).

[11] *Id.* at 14-15.

While different facilities will have different needs, URS identifies activated carbon injection ("ACI"), electrostatic precipitator upgrades, and dry FGD systems as the controls most likely to be chosen for control of mercury, non-mercury HAP metals and acid gases, respectively. These systems all

[Page 10]
have installation times of three years or less, with ACI able to be installed in 18 months or less.[12] Dry sorbent injection ("DSI") systems, which will likely be the technology of choice for acid gas control for low sulfur coals requiring treatment,[13] can be installed in 12 months or less.[14] EGU owners who act promptly will have sufficient time to comply with the Toxics Rule before the compliance deadline in late 2014 or early 2015.[15]

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[12] *Id.* The Toxics Rule will not generally require installations of wet scrubbers. URS notes that wet FGD systems require from 24 to 44 months to install, but this time period includes planning and design, which could have been started when the Rule was proposed.

[13] For many facilities burning coals with low chlorine content, there will be little or no need for any acid gas removal. Approximately 70% of the subbituminous units reflected in the ICR database burn fuel with chlorine content below the proposed HCl emission limit, suggesting no HCl controls are necessary to comply with the Rule. Some of these facilities might install DSI as a precautionary measure or to provide fuel flexibility, but some may install no acid gas controls at all.

[14] URS Technology Assessment at A-11; NESCAUM Report at 26-27.

[15] *See* URS Technology Assessment at 1-2; NESCAUM Report at 26-27.

Left with the realization that there is overwhelming evidence that controls can be installed within three years at individual plants, some commenters suggest that it will be impossible for emissions controls to be installed on every EGU that needs them before the Toxics Rule compliance deadline, or, alternatively, that it will cost them more money to install the controls in three years. The latter argument is readily dismissed. As noted, many companies planned prudently knowing that these rules were coming. Those that failed to do so should not be permitted to use their own inaction to justify more time.[16]

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[16] Some companies operating EGUs in regulated states claim that the additional layer of review by state utility or public service commissions will impose delays that will prevent them from timely completing construction of required controls. This argument denies the core tenet of rate regulation: that a public utility is entitled to recover its capital costs, with a return on investment, and its operating costs through regulated rates. The standard that is applied is a standard of "reasonable prudence," which entitles a utility to recover its reasonably prudent expenditures. Unless an existing EGU could be more costeffectively replaced with a new, cleaner, more efficient EGU than upgraded to comply with the Toxics Rule, it is unfathomable that a state utility or public service commission would find that expenditures necessary to comply with a federal environmental regulation do not meet the standard of "reasonable prudence." Prudently incurred costs to comply with environmental regulation are routinely recoverable. *See, e.g.*, *Midwest Independent Transmission System Operator, Inc.*, 109 FERC ¶ 61,157 at P 293 (2004) ("Clearly, reasonable and prudent costs for repairs or upgrades needed to meet applicable environmental regulations or local operating permits that would not be incurred otherwise should be fully recoverable under any resulting [System Supply Resources] contract."); *Promoting Wholesale Competition Through Open Access Non-*

Discriminatory Transmission Services by Public Utilities, Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, Order No. 888, FERC Stats. & Regs. ¶ 31,036 (1996), *order on reh'g*, Order No. 888-A, FERC Stats. & Regs. ¶ 31,048, *order on reh'g*, Order No. 888-B, 81 FERC ¶ 61,248 (1997), *order on reh'g*, Order No. 888-C, 82 FERC ¶ 61,046 (1998), *aff'd in relevant part sub nom. Transmission Access Policy Study Group, et al. v. FERC*, 225 F.3d 667 (D.C. Cir. 2000), *aff'd sub nom. New York v. FERC*, 535 U.S. 1, 122 S. Ct. 1012, 152 L. Ed. 2d 47 (2002) ("There are legitimate costs of environmental compliance that should be reflected in jurisdictional rates to the extent prudently incurred, just as the prudent costs of complying with, for example, occupational health and safety requirements designed to protect utility employees should be reflected in jurisdictional rates."); *In re: Petition by Florida Power & Light Company to recover Scherer Unit 4 Turbine Upgrade costs through environmental cost recovery clause or fuel cost recovery clause*, 2011 Fla. PUC LEXIS 67, *5 (Fl. PSC 2011) (explaining how Florida law allows for the recovery of costs prudently incurred to comply with a governmentally imposed environmental regulation). Companies making capital expenditures in reasonable expectation of future events may recover their expenses even where that expectation does not become a reality. *See, e.g., Pennsylvania Power Co.*, Opinion No. 211, 26 FERC ¶ 61,354 (1984) (allowing amortization over a 10-year period of the losses associated with four cancelled nuclear units); *Northern States Power Co.*, Opinion No. 134, 17 FERC ¶ 61,196 (1981) (allowing amortization of estimated losses associated with an abandoned electric generating facility); *New England Power Co.*, Opinion No. 49, 8 FERC ¶ 61,054 (1979) (allowing amortization of losses associated with a cancelled oil-fired generating unit); *In re: Application of Otter Tail Power Company for Authority to Increase Rates for Electric Utility Service in Minnesota*, 2011 Minn. PUC LEXIS 139 (Minn. PUC 2011) (allowing cost recovery for an abandoned coal-fired plant). Thus, companies in regulated states have little or no excuse if they have failed to initiate capital projects in reasonable anticipation of the Toxics Rule's requirements, which were anticipated by comments by a well respected association of state air regulators almost a decade ago. *See* NESCAUM

[Page 11]

The argument that controls cannot be installed at every plant in three years because there is insufficient labor and materials is a tired excuse for delay. The Institute of Clean Air Companies ("ICAC") represents companies that are in the business of installing controls. As they noted in their 2010 report to Congress, these companies do not anticipate any workforce or material problems:

> [I]ndustry stakeholders raised this exact concern when EPA proposed the NO_x SIP Call rule in 1998 and, again, when EPA proposed the Clean Air Interstate Rule (CAIR) in 2005. Notably however, these were concerns raised primarily in advance of the

[Page 12]

> finalization of rules, and in both cases proved unfounded as the stationary source air pollution control and measurement (APC) industry satisfied demand for labor and other resources placed upon us and related industries. These concerns and doubts are being raised again; however, based on a history of successes, we are now even more resolute that labor availability will in no way constrain the industry's ability to fully and timely comply with the proposed interstate Transport Rule and upcoming utility MACT rules. Contrary to any concerns or rhetoric pointing to labor shortages, we would hope

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Comments on Finding Revision; State and Local Air Pollution Control Officials Recommendations.

that efforts that clean the air also put Americans back to work.[17]

EGU owners who are acting now in response to the proposed Toxics Rule are obtaining contractual commitments from reputable firms for the installation of FGD systems before the Toxics Rule compliance deadline, in one case up to a year before that deadline. This is not surprising. As noted by ICAC, the industry can meet any scheduling challenges that may arise in coordinating the installation of pollution controls.[18] The industry's history of success with emission control installations offers many examples of projects concluded in three years or less.[19] EPA need not and should not depart from the plain requirements of the statute to

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[17] David C. Foerter, Executive Director of Institute of Clean Air Companies, Letter to Senator Thomas Carper (Nov. 3, 2010) (attached hereto as Exhibit 8).

[18] For example, in the three year period 2008-2010, coal-fired plants installed FGD systems on 60 gigawatts ("GW") of generation capacity. *See* M.J. Bradley Report at 19. By comparison, EPA predicts that only 21 GW of capacity will be equipped with FGD in response to the Toxics Rule in the three and a half years before the Toxics Rule compliance date. "Regulatory Impact Analysis of the Proposed Toxics Rule: Final Report" at 9-13, tbl. 9-4 (March 2011) ("RIA"), *available at* http://www.epa.gov/ttn/ecas/regdata/RIAs/ToxicsRuleRIA.pdf.

[19] *See, e.g.*, EPA, "An Assessment of the Feasibility of Retrofits for the Toxics Rule," at 14 (March 9, 2011), *available at* http://www.epa.gov/ttn/atw/utility/pro/feasibility_retrofit.pdf (identifying more than a dozen wet FGD retrofit projects completed in three years). Ameren Energy Generating Co. and Detroit Edison plan to install FGD systems at plants in Illinois and Michigan before the Toxics Rule would take effect. *See* McIlvaine Co., "FGD and DeNox Newsletter," June 2011, No. 398.

accommodate EGU owners who have procrastinated in installing controls, and who continue to do so even in the face of the proposed Toxics Rule. Rather, EPA should require all owners to comply with the Toxics Rule in three years, as provided in the Clean Air Act

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[Page 21]

EPA has two options for accommodating Consent Arrangements. First, EPA could authorize state permitting agencies to provide facilities subject to a Consent Arrangement with the same one-year extension from the applicable statutory deadline "for the installation of controls" under section 112(i)(3)(B) available to other sources, assuming those facilities intend to install controls before the end of 2015. EPA could exercise its discretion as to whether to require facilities subject to a Consent Arrangement to comply with the same interim operating conditions we advocate in Comment 1.4, above.

The second option available to EPA is to enter into a "wrap-around" consent order or consent decree that would incorporate additional requirements necessary to comply with the Toxics Rule beyond those required in the existing Consent Arrangement. This task must be approached on a case-by-case basis, with the judicious use of the enforcement discretion of EPA and state permitting agencies. As noted above, existing Consent Arrangements are unlikely to provide for the installation of emission controls sufficient to comply with the Toxics Rule. EGU operators who are parties to such arrangements will bear the burden of deciding whether to seek additional relief, or to comply with

the rule on time. Some Consent Arrangements will be inadequate in scope or alacrity, or both, and will need to be supplemented either by a "wraparound" consent order or decree, or by an amendment to the existing arrangement. Ultimately, however, the same enforcement discretion that formed the basis of the existing Consent Arrangements will be applied to determine if, and how, they must be modified, and the operating conditions that should be applied during the period of extension. Only in this way can EPA and state permitting agencies conserve the benefits of these Consent Arrangements without sacrificing the overwhelming health and economic benefits that the Toxics Rule will provide. [28]

2. IMPLEMENTATION OF THE TOXICS RULE WILL NOT IMPAIR RELIABILITY OF THE ELECTRICITY SUPPLY.

2.1 EPA Properly Concluded That Reliability Will Not Be Jeopardized By The Toxics Rule.

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emissions, many EGUs would still require mercury or particulate matter emission controls in addition to FGD systems in order to comply with the Toxics Rule.

[28] A consent order extending the compliance date for more than one year would effectively authorize an ongoing violation of the Act. Such an extension would not prohibit the state or the Administrator from assessing civil penalties for such violations, 42 U.S.C. § 7413(a)(4), and may not bar a citizen suit seeking the imposition of penalties for such violation, *id.* § 7604. If EPA or the state permitting agency assesses a civil penalty in the Consent Arrangement, it must assure that any penalty assessed for the extension period will be sufficient to remove the "economic benefit of noncompliance." *Id.* § 7413(e)(1).

Ample support exists for EPA's conclusions that coal-fired power plant retirements will be less than some estimates predicted, retirements can be managed, and new capacity can be developed to ensure that the electric grid will continue to provide a reliable

[Page 22]
electric power supply after the Toxics Rule takes effect. *See* 76 Fed. Reg. at 25,054. [29] A December 2010 report by Charles River Associates, [30] an August 2010 report by M.J. Bradley & Associates and the Analysis Group, [31] a June 2011 update of that report, [32] a May 2011 report by Drs. Susan Tierney and Charles Cicchetti peer reviewing Edison Electric Institute ("EEI") modeling, [33] and the results of the

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[29] EPA's grid reliability analysis further determined that "with the addition of very little new capacity, average reserve margins are significantly higher than required." 76 Fed. Reg. at 25,055; *see also* Technical Support Document: "Resource Adequacy and Reliability in the IPM Projections for the Toxics Rule," at Appendix A2, *available at* http://www.epa.gov/ttn/atw/utility/pro/resource_adequacy_rel.pdf.

[30] Ira Shavel & Barclay Gibbs, Charles River Associates, "A Reliability Assessment of EPA's Proposed Transport Rule and Forthcoming Utility MACT" (Dec. 16, 2010) ("CRA Report", attached hereto as Exhibit 9)

[31] M.J. Bradley Report (Exhibit 2).

[32] Michael J. Bradley, Christopher E. Van Atten, & Amlan Saha (M.J. Bradley & Associates LLC) & Susan F. Tierney (Analysis Group), "Ensuring a Clean, Modern Electric Generating Fleet while Maintaining Electric System Reliability: Summer 2011 Update," (June 2011) ("M.J. Bradley Update", attached hereto as Exhibit 10).

[33] Susan F. Tierney & Charles Cicchetti, "The Results in Context: A Peer Review of EEI's 'Potential Impacts of

most recent PJM capacity auction all confirm and support EPA's conclusion that compliance with the Toxics Rule within the statutorily-provided three year timeline will not impair grid reliability.

(a) *Independent analyses support EPA's retirement projections, and criticisms of EPA's projections are overstated.*

EPA's "base case" coupled with the Toxics Rule estimates a total of 35 GW will retire in 2015. 76 Fed. Reg. at 25,075 (Table 24). Of these projected retirements, only 15 GW are coal-fired power plants. *Id.* Modeling done by Charles River Associates in anticipation of the Toxics Rule and the Cross-State Air Pollution Rule ("CSAPR")[34] estimated that coal retirements could be as high as 39 GW nationwide by 2015, but determined that the projected retirements will result in only modest or manageable capacity shortfalls, if any.[35] All five

[Page 23]
eastern RTOs would be capable of maintaining reliability without any new resources beyond those under construction, even under the more

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Environmental Regulation on the U.S. Generation Fleet" (May 2011) ("Tierney-Cicchetti Peer Review Report", attached hereto as Exhibit 11).

[34] The Cross-State Air Pollution Rule formerly was referred to as the Clean Air Transport Rule.

[35] *See* CRA Report at 28 (predicting two NERC regions will have *de minimis* shortfalls, one NERC region will have a modest shortfall, three subregions within the Southeast Reliability Corporation ("SERC") region will have shortfalls of varying degrees, all of which are manageable).

conservative scenario modeled before the Rule was proposed.[36] Further, any focus only on retirement estimates is overly narrow, and one must also consider other factors such as transmission capacity and demand in evaluating claims that the Rule will impair reliability. M.J. Bradley's analysis confirms that each NERC reliability region has substantial excess capacity.[37] Electricity demand has been materially and permanently reduced by technological improvements in managing demand response and energy efficiency gains, in addition to temporary reductions due to economic conditions in recent years. These factors increase the cushion to manage the effect of retirements to ensure minimal impact on reliability.[38]

Retirements are driven by many economic factors, not simply the cost of control equipment. These factors include the cost of alternative generation using natural gas, the cost of implementing demand response measures that can be bid into capacity markets, and the cost of continuing to generate power from an existing unit. Regardless of the costs associated with the Toxics Rule and other EPA electric power industry

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[36] CRA Report at 5. The CRA Report "assumed the most expensive technologies will be required, that is, activated carbon sorbent injection ., fabric filter, and wet [FGD] scrubbers." *Id.* at 9.

[37] M.J. Bradley Report at 4; see also CRA Report at 5-6.

[38] *See* M.J. Bradley Report at 4; CRA Report at 5-6; Ade Dosunmu, "Up in Smoke," Fortnightly's Spark (June 29, 2011) ("Up in Smoke", attached hereto as Exhibit 12) (indicating that demand response resources cleared the PJM capacity auction, displacing coal-fired generation that was offered).

regulations, some power plants were already economically unsustainable. As M.J. Bradley points out, "Of the 122 coal units in PJM with capacity less than or equal to 200 MW, 35 failed to recover their avoidable costs and another 52 were close to not recovering those costs. Therefore, in PJM in addition to approximately 10 GW of coal generation that has or will be retired during the seven years from 2004 to 2011, another 11 GW faces a troubling economic outlook." [39] This was confirmed by the most recent PJM capacity auction, where approximately 6.9 fewer GW of coal-fired capacity cleared the auction (1.85 fewer GW were offered) as compared with the prior year's auction, and an additional 4.836 GW of new demand response (energy efficiency) resources cleared the auction. [40] Thus, some claims linking retirements to the Toxics Rule are overstated and misleading. Recently, American Electric Power attempted to link its planned plant closures to the Toxics Rule, but those plants already are slated to either close or to upgrade controls to comply with *existing* laws. [41] As independent analyses have confirmed, projected retirements

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[39] M.J. Bradley Report at 19-20.

[40] *See* "Up in Smoke."

[41] The plant closures announced by American Electric Power in its June 9, 2011 press release had nothing to do with the proposed Toxics Rule. The closing plants were either already required to close or upgrade under an existing consent order. *See United States, et al. v. American Electric Power Service Corp., et al.*, No. C2-99-1250 (S.D. Ohio), *available at* http://www.epa.gov/compliance/resources/decrees/civil/caa/americanelectricpowercd.pdf.

[Page 24]
attributable to the Rule itself are manageable, and those units most likely to retire are older units, which are less likely to be adequately controlled and already are nearing the end of their life expectancy.[42] Indeed, some respected economic analysts suggest that many companies have been keeping uneconomic coal plants open because they have "ignored economic reality," unrealistically hoping that "crummy economics" for coal-fired generation would improve.[43]

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[42] *See* CRA Report at 5, n.8 (noting that the average age of units in the Eastern Interconnection projected to retire by 2015 is 55 years).

[43] Analysts at Credit Suisse reported:

"If the EPA rules were not bad enough for coal generators, we think a large chunk of the US coal fleet is vulnerable to closure simply due to crummy economics where we see coal pricing at a premium to natural gas out the forward curve when adjusting on an electricity equivalent basis. Awful energy margins suggest to us that owners should be reevaluating their coal fleets due to pure energy economics before even taking on the burden of a capex for environmental control equipment.

We have seen some operators already make this decision but many have ignored this economic reality in our minds reflecting a combination of (a) eternal optimism that commodity prices will revert to benefit coal plants (b) coal plant dispatch decisions being made on realized commodity prices that benefit from legacy in the money hedges for both coal and transport that defers the reality of poor economics for a time and (c) some fading hope that carbon or other US policy would deliver a set of incentives to close plants and therefore less urgency to do so without remuneration.

In contrast to many who think generators will wait until the last possible moment to close at risk coal plants, we think owners will be more motivated to close plants as they realize that the environmental capex obligations are unavoidable and

[Page 25]

One reason for this, as explained more fully in comments 1 and 7 herein, is that many existing sources already have controls adequate to achieve the proposed emission limitations,[44] and many sources will be able to comply with the Rule without having to install FGD technology.[45] Indeed, 174 GW of units equipped with wet scrubbers are in EPA's "base case" for the Toxics Rule and only one additional GW of wet scrubbers will be required to meet the Toxics Rule.[46] Much of the coal-fired fleet already has installed or plans to install scrubbing technology. EPA's finding that over 50% of the fleet is already equipped with scrubbers and its estimate that this number will increase to nearly two-thirds

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the realized / projected energy margins are inadequate to justify running the plants (before they try to afford the capex). Clearly some game theory will exist for plants that are 'on the bubble' as owners wait for others to close which should improve market pricing but we see a realistically healthy chunk of the fleet 'under the bubble'."

Dan Eggers, Kevin Cole, Yang Y. Song & LinLin Sun, Credit Suisse Equity Research, "Growth From Subtraction, Impact of EPA Rules on Power Markets," at 8 (Sept. 23, 2010) ("Credit Suisse Report", attached hereto as Exhibit 13).

[44] *See* M.J. Bradley Update at 8-9.

[45] *See* M.J. Bradley Update at 8-11; Jennifer Macedonia, et al., Bipartisan Policy Center, "Environmental Regulation and Electric System Reliability," at 15 ("BPC Report"), *available at* http://www.bipartisanpolicy.org/sites/default/files/BPC%20Electric%20System%20Relia bility.pdf ("[T]o meet the acid gas HCl limit at uncontrolled plants, it may be necessary to choose between a wet scrubber, a dry scrubber and dry sorbent injection.").

[46] RIA at 8-14, fig. 8-6.

by 2015, 76 Fed. Reg. at 25,054, is consistent with the findings of at least three independent reports.[47]

Some analytical evaluations that suggest EPA has understated the potential impacts to electric reliability suffer from flaws that lead to inflated retirement predictions. For example, EEI and its members commissioned a report titled "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet," dated January 2011. The report uses ICF International's Integrated Planning Model to model a reference case and seven alternatives, each composed of a different set of variable assumptions related to regulatory scenarios. EEI's analysis determined that under some scenarios, unplanned coal retirements could be as high as 59 GW in 2015 over the reference case of 16 GW of unplanned coal retirement. However, EEI's report "was based upon worst-case assumptions which have not materialized and upon climate change legislation

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[47] *See* M.J. Bradley Update at 10 (estimating that approximately 60% of the U.S. coal fleet has scrubbers installed or under construction); Hugh Wynne, Francois D. Broquin, & Saurabh Singh, Bernstein Research, "U.S. Utilities: The EPA's Hazardous Air Pollutants Rule Is Due by March 16. What to Expect? Could Trona Save the Day?" at 10 (Feb. 16, 2011) (attached hereto as Exhibit 14) ("[W]e estimate the net generation of the U.S. coalfired fleet over the twelve months through July 2010 at 1,885 million megawatt hours ("MWh") of electricity. Of this total, 1,171 million MWh, or 62%, was produced by units already equipped with FGD or where plans have been announced to install FGD in the next two years."); Credit Suisse Report at 6 (finding that 53% of coal-fired capacity is presently equipped with scrubbers).

never enacted into law."[48] The Tierney-Cicchetti Peer Review Report peer

[Page 26]
reviewed EEI's report, and determined that the unplanned coal unit retirement levels and cost estimates were overstated.[49]

EEI's report resulted in inflated unplanned coal retirements due to assumptions that were not reasonable to include at the time the analysis was undertaken. First, EEI ran modeling scenarios assuming that the Waxman-Markey climate change bill passed both houses of Congress, despite the fact that it had long since languished in the Senate. Second, the report assumed that the Clean Water Act section 316 cooling tower regulations would mandate a onesize- fits-all standard requiring cooling towers, even though Administrator Jackson had already confirmed in a letter to Congress that EPA would not take such an approach.[50] That proposed rule, in fact, does not take the approach modeled by EEI.[51] Third, the EEI modeling did not use the actual limits proposed in the Toxics Rule, but a far more restrictive scenario.[52] The Tierney-Cicchetti Peer Review Report found that only one of

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[48] Tierney-Cicchetti Peer Review Report at 1.

[49] *Id.* at 4.

[50] *Id.* at 2-3.

[51] *See* "National Pollutant Discharge Elimination System – Cooling Water Intake Structures at Existing Facilities and Phase I Facilities: Proposed Rule," 76 Fed. Reg. 22,174 (April 20, 2011).

[52] Tierney-Cicchetti Peer Review Report at 5.

EEI's scenarios represented a plausible regulatory scenario, but determined that the incremental unplanned coal retirements modeled under this scenario for 2015 (totaling 24 GW) should be considered the upper end of potential retirement impacts, since it still overstates the impacts of the section 316 rule.[53] Given the flaws underlying EEI's assumptions, Tierney and Cicchetti concluded "nothing in the Report changes our conclusion that the industry is well-positioned to comply with the actual regulations on the proposed schedule and yield significant benefits to the Nation."[54]

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[53] Tierney-Cicchetti Peer Review Report at 9-11. The "Alt Air" and "Alt Water" scenarios most closely resemble EPA's actual rules and the EEI report never modeled these two "alternative" scenarios together. In addition, the EEI study assumed unreasonably high costs for carbon emissions, again producing unrealistically high retirements.

[54] *Id.* at 13. Numerous other reliability studies have been prepared, but "[a]s EPA's proposed air pollution regulations are more flexible than had been anticipated by some of those studies' 'worst-case' scenarios and given the industry can supply needed capacity through a variety of resources, the recent PJM auction results suggest that coal plant retirements will likely fall at the lower range of prior estimates." M.J. Bradley Update at 17. By way of an additional example, the October 5, 2010 NERC report anticipated the following investments for MACT compliance: wet FGD added for all coal types that did not already have wet or dry FGD; selective catalytic reduction ("SCR") retrofits added for bituminous coal; and fabric filter systems with halide-treated ACI systems added for all coal types, if not already present. *See* NERC, "2010 Special Reliability Scenario Assessment: Resource Adequacy Impacts of Potential U.S. Environmental Regulations," at 50 (October 2010), *available at* http://www.nerc.com/files/EPA_Scenario_Final.pdf.

[Page 27]

The conclusions by Drs. Tierney and Cicchetti, Charles River Associates, and M.J. Bradley have been confirmed by the free market in the results of the most recent PJM Reliability Pricing Model auction. As confirmed by the results of the auction covering the period from May 31, 2014 through June 1, 2015, during which both the CSAPR and the Toxics Rule will be in effect, PJM will have "more than enough capacity" to satisfy NERC reliability standards.[55] More than 4 GW of new capacity entered the market in this auction, including both new generation and new demand-side resources, and approximately 5 GW of coal capacity that was offered (and had cleared prior auctions) failed to clear the most recent auction.[56]

(b) *Gas-fired units have substantial unused capacity.*

Health and environmental protection should not be thwarted to prolong the lifespan of already

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[55] Letter from Susan F. Tierney to EPA Administrator Lisa Jackson dated May 17, 2011, at 2 ("Tierney Letter", attached hereto as Exhibit 15); *see also* M.J. Bradley Update at 5 (PJM auction results yielded a 20.6 percent reserve margin for the region).

[56] *See* Tierney Letter at 2; M.J. Bradley Update at 16 (demand response resources increased by 4,836 MW, commitments to conserve energy through energy efficiency increased by 142.7 MW, and the auction procured 695 MW of wind power and 45.6 MW of solar power); "Up in Smoke" (approximately 6.9 GW of coal-fired generation capacity that was previously a part of the PJM market was either withdrawn or failed to clear the auction and was replaced by 4.836 GW of *new* demand management resources).

economically troubled units, particularly when the long-term viability of those existing coal- and oil-fired EGUs is threatened by the development of a clean, domestic source of fossil fuel that can be used in existing, underutilized generating units fired with natural gas. The domestic natural gas industry has increased production and driven prices downward due to the development of an abundant, domestic shale gas resource, located in the same region as many of the antiquated, dirty coal-fired plants that will be retired.[57] In 2007 and 2008, coal enjoyed a price advantage relative to natural gas.[58] As a result, existing gas-fired plants were comparatively underutilized, operating at an average of 33% of the time compared to 56% for coal-fired units.[59] As gas prices have fallen relative to coal, gas-fired capacity factors have

[Page 28]
increased.[60] Existing gas units have significant untapped potential, which can be utilized to

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[57] *See* BPC Report at 11 ("The discovery of vast shale gas basins in the United States, combined with technological advances in horizontal drilling and hydraulic fracturing that make it possible to access these resources, has dramatically changed the domestic natural gas supply outlook. As new shale gas resources have been developed in recent years, natural gas prices have declined. They are now projected to remain at levels lower than during the previous decade.") (internal references omitted).

[58] M.J. Bradley Report at 13.

[59] *Id.*

[60] *See* Brandon Blossman & George O'Leary, Tudor Pickering Holt, "Crack a Window US Getting Gassier," at 9-11 (2011) ("TPH Report", attached hereto as Exhibit 16) (describing changes in the prices of coal and natural gas, and indicating

maintain reliability without the need to undertake new construction.[61] Indeed, if all coal-fired units with a name plate capacity of less than 200 MW were retired, the power produced by these retired units could be replaced using only 5% of the *unused* capacity of existing combined cycle gas units.[62] Moreover, as Table 1 below details, in 2010 there was already new capacity announced, planned or seeking grid interconnection studies, which cumulatively would add a total of 55.5 GW of power across the grid by 2013:

Table 1: Proposed New Build – 2013[63]

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that the 230 GW fleet of CCGTs ran at a 40% capacity factor in 2010).

[61] *Id.; accord*, TPH Report at 3, 11 (reporting that the CCGT fleet ran at 40% capacity in 2010).

[62] In 2008, the 17 GW of coal-fired units of less than 200 MW achieved a 45% capacity factor, while the 228 GW of CCGT units achieved a 35% capacity factor. *See* M.J. Bradley Report at 7 & tbl. 4.

[63] Reproduced from M.J. Bradley Report at 12, tbl. 3.

Table 1: Proposed New Build – 2013[68]

NERC Region	New Generation Proposed to Be Built (in Transmission Generation Queues for 2013)
TRE	4.3 GW
FRCC	2.0 GW
MRO	3.6 GW
NPCC	7.5 GW
RFC	8.7 GW
SERC	10.3 GW
SPP	2.8 GW
WECC	16.3 GW
Total	55.5 GW

Retirements are attributable to the age of the plants and the inability of those plants to justify further capital investment, and where such older units are currently operated to maintain electrical grid reliability, substantial capacity is available to avoid a shortfall.

2.2 In Those Rare Cases Where Reliability Could Be Impaired By A Plant Closure, The Act And Federal Grid Planning Tools Together Provide Adequate Protection For Reliability.

A number of grid planning tools also can be implemented to coordinate any retirements.[64] Regional transmission organizations typically have advance notice requirements for proposed unit retirements. PJM requires a 90-day notice, MISO requires a 26-week notice, and NYISO requires a 90-day notice for smaller plants and a 180-day notice for units 80 MW or larger.[65] In many RTOs, market safeguards exist that require advance planning to avoid capacity shortfalls. In PJM Interconnection, for example, the Reliability Pricing Model Base Residual Auction is held approximately 36 months prior to the delivery year, and accepts offers for proposed

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[64] *See generally* Paul J. Miller, NESCAUM, "A Primer on Pending Environmental Regulations and their Potential Impacts on Electric System Reliability," at 20, tbl. 10 (March 30, 2011) (attached hereto as Exhibit 17) (listing electric sector options to address environmental "goals" and reliability pertaining to generation, planning, demand-side, transmission and pollution controls). Some of these tools are discussed in more detail in these comments.

[65] BPC Report at 36-37.

resources.[66] The cost of retrofits can be included in the offer price, and if the offer that includes retrofit costs does not clear the auction, the resource owner can file a deactivation request and retire that unit at the beginning of the delivery year covered by the Base Residual Auction in which it did not clear.[67] PJM conducts reliability impact studies for all units that announce retirement so that any reliability impacts can be avoided through transmission upgrades or other means. If such other measures cannot be implemented in time for the scheduled closure, PJM may request "reliability must run" ("RMR") agreements for those generation units that PJM determines are needed to run past their proposed retirement date to ensure reliability.[68] While the specific reliability review procedures differ among RTOs, each has a practice to assure that threats to reliability are identified early enough to avoid them.

An RMR agreement, implemented through a consent order or consent decree, can provide a tailored, site-specific solution to assure that environmental protections are observed to the greatest extent possible during the typically brief period necessary for completion of the transmission or generation upgrades that will maintain reliability after an EGU is retired. Exelon

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[66] *See* CRA Report at 24.

[67] CRA Report at 25.

[68] CRA Report at 26. As discussed elsewhere, the most recent PJM auction confirms that adequate capacity will exist after implementation of the Toxics Rule. *See* Tierney Letter at 2.

[Page 30]
has direct experience with such agreements within PJM, the largest RTO in the nation.[69] In late 2009, Exelon proposed to retire four old, fossil-fired EGUs in southeast Pennsylvania as of May 2011. Like EGU owners who will retire units in response to the Toxics Rule, Exelon chose to retire these units because it could not justify economically the substantial capital investments required to comply with new requirements in its wastewater discharge permits issued by the Pennsylvania Department of Environmental Protection ("PADEP"). Exelon's decision to retire the facilities as of May 2011 resolved its ongoing permit disputes with PADEP, but PJM found that the closure would adversely affect reliability, and requested Exelon to continue to make two of the units available until such time as transmission upgrades that would resolve the reliability concern could be completed. To reconcile these competing environmental and reliability concerns, Exelon, PJM, and PADEP worked closely together to reach a series of agreements. Exelon and PADEP entered into a consent decree that authorized the continued operation of the two units beyond May 2011, only when necessary to preserve electric system reliability, without requiring the additional capital investment necessary to comply with the revised wastewater permits.[70] Like Exelon,

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[69] PJM Interconnection manages the high-voltage electric grid and the wholesale electricity market that serves 13 states and the District of Columbia, including all of Pennsylvania, New Jersey, Delaware, and Maryland.

[70] *See* "Operating Procedures for Cromby Generating Station Unit No. 2 and Eddystone Generating Station Unit No. 2 as

EGU owners confronted with similar concerns by the Toxics Rule can and must engage both environmental agencies and RTOs to assure both maximum compliance with environmental laws and minimum disruption to electric reliability.

Whether within or outside of an RTO, if the reliable supply of electric power may be compromised by compliance with environmental regulations, the United States Department of Energy ("DOE"), EPA, and state agencies can and do work together to strike the appropriate balance in protecting the public's interest in both objectives. The Federal Power Act authorizes DOE to order generation, delivery, interchange, or transmission of electric energy in response to a shortage of electric energy. *See* 16 U.S.C. § 824a(c).[71] While the Secretary of DOE has

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Required for Reliability Purposes," (May 27, 2010) (attached hereto as Exhibit 18).

[71] During the 2000-01 California electricity crisis, the Secretary of Energy issued numerous orders finding that an electricity shortage existed in California and requiring an extensive list of electric generation owners in the Western United States to sell electricity to the California Independent System Operator that is available in excess of electricity needed by each entity to render service to its firm customers. DOE Order Pursuant to Section 202(c) of the Federal Power Act (Dec. 14, 2000); Amended Order Pursuant to Section 202(c) of the Federal Power Act (DOE Dec. 20, 2000); Amendment No. 2 to Dec. 14, 2000, Order Pursuant to Section 202(c) of the Federal Power Act (DOE Dec. 27, 2000); Amendment No. 3 to Dec. 14, 2000, Order Pursuant to Section 202(c) of the Federal Power Act (DOE Jan. 5, 2001); Order Pursuant to Section 202(c) of the Federal Power Act (DOE Jan. 11, 2001); Amended Order Pursuant to Section 202(c) of the Federal Power Act (DOE Jan.

[Page 31]

invoked this authority infrequently, it has been used to require continued operation of units needed to meet electric demand, while also requiring the use of pollution control equipment to minimize the exceedance of National Ambient Air Quality Standards ("NAAQS").[72]

Federal energy regulators continue to tighten transmission planning requirements to ensure that the transmission grid is prepared for the transition of the fleet that will occur as older, less efficient coal plants retire. Last month, the Federal Energy Regulatory Commission ("FERC") released a new rule that will require transmission planners to

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17, 2001); Amendment No. 2 to Jan. 11, 2001, Order Pursuant to Section 202(c) of the Federal Power Act (DOE Jan. 23, 2001).

[72] In 2005, the Virginia Department of Environmental Quality found that Mirant's Potomac River Generating Station caused or contributed to exceedances of NAAQS. The Department demanded that Mirant take immediate action to "ensure protection of human health and the environment." Mirant reduced production, and eventually shut down all generating units. In response to an emergency petition under the Federal Power Act, the Secretary of DOE ordered, *inter alia*, that Mirant operate the plant when one or both transmission lines serving the D.C. area were out of service, and "produce the amount of power (up to its full capacity) needed to meet demand." *See* DOE Order No. 202-05-3, Docket No. EO-05-1 (Dec. 20, 2005), *available at* http://www.energy.gov/news/archives/documents/FinalDOEOrderDCPSC202-05-3.pdf, at VI.A. EPA subsequently issued an administrative order by consent to Mirant that required the plant to "take steps to limit the emission of sulfur from each boiler while meeting emergency demand." *See* Press Release, EPA, "EPA Issues Administrative Order to Mirant Potomac River—Order Sets Schedule for Mirant to Comply with Clean Air Standards" (June 2, 2006) (attached hereto as Exhibit 19).

consider public policy laws and regulations, such as the Toxics Rule, when developing long-term system plans. [73] In that rule, FERC required all transmission planners to identify transmission needs driven by public policy requirements and to evaluate potential solutions to meet those needs. [74] In particular, FERC authorized planners to require increased information from generators regarding retirements if they believe it is necessary to implement the evaluation process. [75] These reforms, which are applicable to every U.S. planning region except the Electric Reliability Council of Texas, [76] will help ensure that the grid is reinforced in areas where generator retirements are likely.

[Page 32]
Even before the new FERC rule, however, formal planning for grid reliability and ongoing assessments of grid reliability were staples of the existing regulatory structure. NERC has promulgated mandatory reliability standards, approved by FERC, requiring transmission planners to assess system performance periodically to ensure that reliable systems are developed with sufficient lead time and continue to be modified or upgraded to meet present

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[73] FERC, "Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities; Final Rule," (issued July 21, 2011), Order No. 1000, 136 FERC ¶ 61,051, (Docket Nos. RM10-23-000 and FERC-2010-0912), pre-publication version available at http://www.ferc.gov/whats-new/comm-meet/2011/072111/E-6.pdf.

[74] *Id.* at 157-160.

[75] *Id.* at 164-65 n.190.

[76] The Electric Reliability Council of Texas region covers 75% of the land area of Texas. *See* http://www.ercot.com/about/.

and future needs.[77] Furthermore, NERC conducts periodic assessments of the reliability and adequacy of the bulk power system in North America and disseminates such assessments to the FERC, other governmental authorities, the electric utility industry, and the public, in accordance with section 215(g) of the Federal Power Act and 18 C.F.R. § 39.11. NERC prepares three reliability assessment reports each year: (1) a long-term reliability assessment ("LTRA") report, (2) an annual seasonal (summer) report and (3) an annual seasonal (winter) report. These reports assess electricity demand and the adequacy of supply throughout the North America bulk power system.[78] Moreover, demand response programs operate in all NERC regions and can be a helpful tool to ensure reliability.[79] These programs involve a contract with a particular electric customer to accept usage restrictions in exchange for lower rates. In most cases, the cost of these programs is less than the cost of constructing a new generation unit, as evidenced by the significant demand response capacity that cleared the most recent PJM capacity auction.[80]

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[77] *See* NERC, "Reliability Standards for the Bulk Electric Systems of North America," Standard TPL-001 through TPL-004, *available at* http://www.nerc.com/page.php?cid=2|20.

[78] NERC, "Reliability Standards Development and NERC and Regional Entity Enforcement," 132 FERC ¶ 61,217 at 63 (2010) (FERC Docket Nos. RR09-7-000 and AD10-14-000), *available at* http://www.ferc.gov/whats-new/comm-meet/2010/091610/E-2.pdf.

[79] *See* M.J. Bradley Report at 14.

[80] Decreasing load "can be more efficient and economical than increasing supply by dispatching generation." *Id.*; *see also* "Up

This array of federal and regional safeguards on reliability provides a strong bulwark against reliability impacts, and assures that any impact that could arise is identified early enough to be avoided. For most EGUs that will be retired, surplus generation capacity and conventional transmission improvements will be sufficient to avoid any reliability impact. However, if the only way to maintain reliability is the continued operation of an EGU for a period of time beyond the Toxics Rule compliance deadline, then even this remedy can be accomplished through an RMR agreement or through an order under the Federal Power Act.

[Page 33]

Under such extreme circumstances, it will be imperative that EPA and state permitting agencies minimize the HAP emissions of such EGUs by imposing the reliability-only dispatch limitation and other restrictions described in Comment 1.4, above. These operating conditions should be included in any consent order or decree, or order under the Federal Power Act authorizing continued operation, and should be accompanied by a charge sufficient to

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in Smoke"; U.S. Department of Energy, "Benefits of Demand Response in Electricity Markets and Recommendations for Achieving Them: Report to the United States Congress Pursuant to Section 1252 of the Energy Policy Act of 2005," (February 2006), *available at* http://www.oe.energy.gov/DocumentsandMedia/DOE Benefits of Demand Response in Electricity Markets and Recommendations for Achieving Them Report to Congress.pdf.

recover any economic benefit received by the owner of a non-compliant EGU.[81]

Ultimately, any circumstance that might present a reliability concern can be addressed by existing practical and legal tools. The vast majority of EGUs either possess the necessary emission controls today or will be able to install them before the compliance deadline in the Toxics Rule, and thus will pose no reliability issue. As discussed in Comment 1 above, a number of flexibility options exist for EGUs that require more time for the installation of controls. When an EGU is to be retired, or needs even greater time to install controls than the Act allows, a resolution that maintains reliability can be reached through the authority under the Federal Power Act, or through the prudent exercise of enforcement discretion in a consent order or consent decree that accommodates both environmental imperatives and reliability concerns. A schematic of all of these options appears in Table 2: Availability of Compliance Flexibility Options.

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[81] EPA has authority to impose a non-compliance charge under section 120, 42 U.S.C. § 7420, a penalty under section 113(d), *id.* § 7413(d), or a charge under section 110(a)(2)(A), *id.* § 7410(a)(2)(A). This penalty or charge must be sufficient to recover the economic benefit of non-compliance to assure that owners of non-compliant EGUs do not reap a profit from continuing violations of the Toxics Rule. For example, the penalty could be based on the avoided cost of emission controls for each ton of HAP emissions above that permitted by the Toxics Rule.

[Page 34]

Table 2: Availability of Compliance Flexibility Options (assumes compliance date of 1/1/2015)

EGU Circumstances		Extension for "Installation of Controls" § 112(i)(3)(B)	Presidential Exemption, § 112(i)(4)	Federal Power Act Order, § 202(c)	Consent Decree/Order
EGUS INSTALLING CONTROLS	Installation of controls or on-site replacement power project cannot be completed by 12/31/2014, but will be completed by 12/31/2015	Available; limited to reliability operations and all available HAP controls required.	Not available, as § 112(i)(3)(B) applies.	Not available, as § 112(i)(3)(B) applies.	Not available, as § 112(i)(3)(B) applies.
	Installation of controls or replacement power project (on-site, off-site or transmission) cannot be completed by 12/31/2015	Not available.	Available if statutory conditions satisfied; limited to reliability operations and all available HAP controls required.	Available if statutory conditions satisfied; limited to reliability operations and all available HAP controls required.	Available, subject to agency enforcement discretion, with conditions to remove economic benefit of noncompliance.
	Installation of controls subject to schedule in federally enforceable consent decree with Title V permitting authority	Available for extension to 12/31/2015.	Available if statutory conditions satisfied; limited to reliability operations and all available HAP controls required.	Available if statutory conditions satisfied; limited to reliability operations and all available HAP controls required.	Available, subject to agency enforcement discretion, with conditions to remove economic benefit of noncompliance.
EGUS TO BE RETIRED	EGU not required for reliability purposes	Not available.	Not available.	Not available.	Not available.
	EGU required for reliability purposes	Not available.	Available if statutory conditions satisfied; limited to reliability operations and all available HAP controls required.	Available if statutory conditions satisfied; limited to reliability operations and all available HAP controls required.	Available, subject to agency enforcement discretion, with conditions to remove economic benefit of noncompliance.

[Page 35]

2.3 Owners Of Affected Sources Have Publicly Confirmed That Reliability Will Not Be Substantially Impaired By The Toxics Rule.

Prudent companies have been aware for several years that the Toxics Rule would be promulgated, and that sources would be expected to comply with the Rule by late 2014 or early 2015. After the decision in *New Jersey v. EPA* in February 2008, a NESHAP for EGUs has been imminent, and the consent decree in *American Nurses Ass'n* affixed a known date by which sources could expect the Rule to be promulgated. Compliance is required by law within three years. Some of the emissions limitations of the proposed Rule fall well within those that should have been expected since at least 2004[82] EGU owners, therefore, have had ample time to consider the potential impacts of the Rule in planning their response. The SEC filings and other publicly available materials from many EGU owners confirm that they have been aware the Toxics Rule was forthcoming and that it would likely require capital investments that could be material.[83] These

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[82] *See* NESCAUM Comments on Finding Revision; State and Local Air Pollution Control Officials Recommendations. In these reports, the well-respected organization of state air regulators opposed EPA's proposed CAMR and suggested that limits similar to those of the Toxics Rule were appropriate.

[83] For example, Allegheny Energy, Inc. (which is now merged with First Energy), reported: "Allegheny is monitoring the EPA's efforts to promulgate hazardous air pollutant rules that will include, but will not be limited to, mercury limits. To establish these standards, the EPA must identify the best performing 12% of sources in each source category and, to that

end, issued an information request to members of the fossil fuel-fired generating industry requiring extensive stack emissions testing on selected generating units. Allegheny completed stack testing for eight of its generating units identified by EPA and submitted all results by September 2010. Depending on the final hazardous air pollution limits set by the EPA, Allegheny could incur significant costs for additional control equipment." Allegheny Energy, Inc., Annual Report (Form 10-K), at 33 (Feb. 23, 2011). Similarly, American Electric Power Company, Inc. reported: "In addition, with the remand of CAMR, Federal EPA will likely establish Maximum Achievable Control Technology (MACT) standards for mercury and other hazardous air pollutants that could require installation of scrubbers on all coal units, regardless of age or size. It would be costly and inefficient to retrofit all of our units with such controls, and we will urge Federal EPA to carefully consider all of the options available to it to avoid such a result. However, we have a number of our older units, including some that are already subject to control requirements under the NSR Consent Decree, for which it may be economically inefficient to install scrubbers or other environmental controls, including CCS. The timing and ultimate disposition of those units will be dictated by environmental regulations, the economics of maintaining or retrofitting the units, transmission requirements, demand for electricity, availability and cost of replacement power, legislative mandates and capital requirements, and regulatory decisions about cost recovery of the remaining investment in retired units. In addition, if some coal units are prematurely forced to retire, we may need to make investments in new transmission lines and substations to create stronger interconnections with neighboring systems." American Electric Power Company, Inc., Annual Report (Form 10-K), at 12 (Feb. 26, 2010). Likewise, Constellation Energy Group, Inc. reported "[T]he EPA announced that it intends to develop new hazardous air pollutant emission standards under the [Clean Air Act] by the end of 2011. Any new standards that require the installation of additional emissions control technology beyond what is required under Maryland's HAA and CPR, which are discussed below, may require us to incur additional costs, which could have a material effect on our financial results." Constellation Energy Group, Inc., Annual Report (Form 10-K),

statements also reflect the fact that prudent companies have already made

[Page 36]
plans for the capital investments needed to comply with the Toxics Rule and other rules. For example, NRG Energy, Inc. reported the following:

> A number of regulations that could significantly impact the power generation industry are in development or under review by the U.S. EPA: CAIR/CATR, NSPS for GHGs, MACT, NAAQS revisions, coal combustion byproducts, and once-through cooling. While most of these regulations have been considered for some time, they are expected to gain clarity in 2011 through 2012. The timing and stringency of these requirements will provide a framework for the retrofit of existing fossil plants and deployment of new, clean technologies in the next decade. The Company has included capital to meet anticipated CAIR Phase I and II, proposed CATR, MACT standards for mercury, and the installation of Best Technology Available, or BTA, under the 316(b) Rule in the current estimated environmental capital expenditures. The Company cannot predict the impact of future regulations and could face additional investments over time. However, NRG believes it is positioned to meet more

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at 16 (Feb. 26, 2010). Relevant excerpts from SEC filings of investor owned electric utilities have been included in Appendix A.

> stringent requirements through its planned capital expenditures, existing controls, and the use of Powder River Basin coal.[84]

Statements in the earnings calls summarized in the M.J. Bradley Update also reflect awareness of the upcoming requirements throughout the industry and exemplify how companies that proactively invested in control technologies are well positioned for compliance.[85] Indeed,

[Page 37]
Wisconsin Energy Corporation and Duke Energy Corporation, for example, tout their efforts to modernize their respective fleets in anticipation of new regulations for the industry.[86]

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[84] NRG Energy, Inc., Annual Report (Form 10-K), at 27 (Feb. 22, 2011).

[85] *See* M.J. Bradley Update at 12-13. The analysts in the Credit Suisse Report suggest that delays in decisions to close or upgrade marginal coal-fired plants may be due, in part, to "eternal optimism that commodity prices will revert to benefit coal plants" and, in part, to expiring contracts for coal priced below market rates. Credit Suisse Report at 8.

[86] *See* Wisconsin Energy Corp., Quarterly Report, (Form 10-Q) at 39 (Aug. 2, 2011) ("The proposed MACT rule is intended to reduce emissions of numerous hazardous air pollutants, including mercury. We are evaluating the potential impact of the proposed rule on the operation of our existing coal-fired generation facilities. Based upon our review, the Milwaukee County, Valley and Presque Isle power plants may require additional modifications. In addition, we believe that our clean air strategy, including the environmental upgrades that have already been constructed and that are currently under construction at our other plants, positions those plants well to meet the proposed requirements."); Duke Energy Corp., Annual

At the state level, many public utility commissions require integrated resource plans, which implement a planning mechanism to assure adequate load is provided.[87] The preparation of these plans provides insight into how utilities view their ability to comply with the Toxics Rule. For example, in its 2010 Integrated Resource Plan, the Georgia Power Company, a subsidiary of Southern Company, indicated that it would restart its 2015 Request for Proposals "to protect reliability and maintain reserve

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Report (Form 10-K), at 34 (Feb. 25, 2011) ("Due to the likelihood of upcoming environmental regulations, including carbon legislation, air pollutant regulation by the U.S. Environmental Protection Agency (EPA) and coal regulation, Duke Energy has been focused on modernizing its generation fleet in preparation for a low carbon future. Duke Energy plans to invest approximately $7 billion in four key generation fleet modernization projects with approximately 2,700 MWs of capacity within it['s] U.S. Franchised Electric and Gas segment. During 2010, Duke Energy continued the construction of Cliffside Unit 6 in North Carolina and the Edwardsport IGCC plant in Indiana and both of these projects are approximately 80% at December 31, 2010. Both are scheduled to be placed in service during 2012. Once in service, Duke Energy will begin retiring older, less efficient coal and gas-fired units. Additionally, Duke Energy has continued construction on its 620 MW combined cycle natural gas-fired generating facilities at its existing Buck and Dan River Steam Stations. The Buck facility is approximately 74% complete and is scheduled to be placed in service in 2011. The Dan River facility is in the early stages of construction and is scheduled to be placed in service in 2012. Duke Energy invested $1.8 billion in the above generation fleet modernization projects in 2010 and $4.6 billion since the inception of these projects.").

[87] *See generally* CRA Report at 27 ("In states with vertically integrated utilities, there is a legal obligation to serve load and state regulatory commissions require long-range integrated resource plans (IRPs).").

margins in the event certain coal-fired units are unable to operate past 2014 Depending on the form of the final [Toxics Rule], certain of the Company's coal-fired power plants may be unable to operate either because controls will likely not be installed by the deadline or because it may be uneconomic to install the controls."[88] In

[Page 38]
addition, the Georgia Power Company explained that it was awaiting additional information on environmental regulatory developments in 2011 to analyze the economics of control options for Plant Branch Units 1 and 2 and Plant Yates Units 6 and 7.[89] Nonetheless, Georgia Power states that it will continue to reliably provide electricity:

> In the short term, Georgia Power has sufficient resources to maintain an adequate planning reserve margin given anticipated demand of its customers and given the current regulations regarding electric generating units. Given the nature of forecasts and the uncertainties of future regulations, *the Company will constantly evaluate its resource needs as they change and will respond as needed to ensure the*

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[88] Georgia Power Company, 2010 Integrated Resource Plan at § 6.3.2 (attached hereto as Exhibit 20).

[89] *Id.* at § 6.3.1; *see also* § 6.2. The IRP references the following environmental rules that it anticipates will affect coal-fired power plants in Georgia: revisions to SO2 and NOX NAAQS; MACT standards for HAP emissions; regulation of coal combustion byproducts; and regulation of carbon dioxide. *See id.* at § 6.3.1.

> *reliability and economics of the Georgia Power system.*
>
> Georgia Power and the System include adequate reserve margins in their respective plans to ensure reliable and cost-effective service to their customers. However, the reliability of the entire southeastern United States region has an impact on Georgia Power because of the integrated nature of the electric system in this area. As part of the normal course of business, the Company monitors the needs and activities of power suppliers within the state and its neighbors. The Company works with these entities to ensure that any insufficiencies in the reserves of its neighbors, were they to occur, will not adversely affect Georgia Power's customers.[90]

Thus, advance planning is already an integral component of providing electric power, and reports submitted to regulatory authorities and investors confirm that the utility industry is confident that it can supply reliable power while complying with the Clean Air Act. Some of the same companies now warning that the Toxics Rule will jeopardize reliability have made strikingly different representations to regulators and their investors.

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[90] *Id.* at § 1.9 (emphasis added). The "System" refers to the Southern Electric System, which is composed of Georgia Power, Alabama Power Company, Gulf Power Company, Mississippi Power Company and Southern Power Company; the System is a member of the Southeastern Electric Reliability Council. *Id.* at § 1.2.

3. EPA PROPERLY CONCLUDED THAT THE BENEFITS OF THE TOXICS RULE EXCEED ITS COSTS.

A legal scholar's observation that "claims that environmental regulation has paid inadequate attention to cost considerations frequently are exaggerated, sometimes woefully,"

[Page 39]
applies with particular force to criticisms of the Toxics Rule based on economic considerations.[91] To the contrary, the *positive* economic impacts of the proposed Toxics Rule strongly militate in favor of its adoption. Contrary to the unfounded assertions by critics of EPA and the Rule, EPA has conducted a technically sound and conservative benefit-cost analysis showing that the proposed Rule's benefits are at least five times as high as its costs. With sound, albeit unduly conservative, econometric modeling, EPA has also determined that the Toxics Rule will promote economic growth and create jobs in both the long and short term. In the report attached as Exhibit 21, Dr. Charles Cicchetti has peer reviewed EPA's analyses, confirming that they meet the standard of peer review but significantly underestimate the Rule's net benefits and positive impact on the nation's economy.[92] His analysis considers just some of the benefits that EPA did not

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[91] Robert V. Percival, "Regulatory Evolution and the Future of Environmental Policy," 1997 U. Chi. Legal F. 159, 176-177 (1997).

[92] Charles J. Cicchetti, "Why EPA's Mercury and Air Toxics Rule is Good for the Economy and America's Workforce," (July 2011) ("Cicchetti Report", attached hereto as Exhibit 21).

monetize in its analysis and the secondary and additional impacts of reduced health costs on downwind economies. Dr. Cicchetti concludes that the proposed Rule will, in fact, create $52.5 to $139.5 billion in net benefits annually, while creating 115,520 jobs, generating annual health savings of $4.513 billion, annual increases in GDP of $7.17 billion, and $2.689 billion in additional annual tax revenues.[93] The proposed Rule will also spur innovation and encourage modernization of the electric generation fleet. The proposal is therefore fully compliant with the spirit and intent of both Executive Order No. 13,563, "Improving Regulation and Regulatory Review," 76 Fed. Reg. 3821 (Jan. 21, 2011), and its predecessors,[94] and section 321 of the Clean Air Act.[95] The positive economic impacts of the Rule make it imperative to adopt and implement the proposed Rule without delay. These analyses also make it clear that there is no need to delay or waste tax dollars on studies that will needlessly duplicate economic analysis that has already been completed.

3.1 Even Though The Positive Economic Effects Of The Toxics Rule Militate In Favor Of Its Quick Adoption, Benefit-Cost Analysis Is Legally Irrelevant To The Establishment Of The MACT Emissions Standards.

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[93] Cicchetti Report at 5.

[94] Exec. Order No. 12,866, 58 Fed. Reg. 51,735 (Oct. 4, 1993), as amended by Exec. Order No. 13,258, 67 Fed. Reg. 9385 (Feb. 28, 2002) and Exec. Order No. 13,422, 72 Fed. Reg. 2763 (Jan. 18, 2007).

[95] 42 U.S.C. § 7621 (requiring analysis of jobs and economic impacts of rules under the Clean Air Act).

Although EPA's and Dr. Cicchetti's economic analyses weigh strongly in favor of the Toxics Rule, they are largely irrelevant to the mixed legal and technical questions relating to whether and to what extent emissions should be regulated under section 112. The limitations

[Page 40]
contained in the Toxics Rule are, with two exceptions, established at the Congressionally mandated floor contained in section 112(d)(3), 42 U.S.C. § 7412(d)(3). It is impermissible even to consider costs in establishing a standard based on the section 112 floor, much less to base the standard on the results of a benefit-cost analysis. *Natural Resources Defense Council v. EPA*, 489 F.3d 1364, 1375-76 (D.C. Cir. 2007); *Nat'l Lime Ass'n v. EPA*, 233 F.3d 625, 640 (D.C. Cir. 2000).[96] By basing the

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[96] EPA established a beyond-the-floor limit for mercury for units capable of burning lignite and for new IGCC units. Although cost is a factor to be considered in making a beyondthe- floor determination of what constitutes MACT, the determination is a costeffectiveness determination rather than a benefit-cost determination, and EPA properly considered cost in making these technical determinations. For example, in the case of the mercury limitation for coal-fired boilers designed for coal less than 8,300 Btu/lb, EPA determined that: (1) the same ACI plus fabric filter technology used by the coal-fired units comprising the group of units on which the mercury emissions floor was based was also in use by lignite units, but (2) the "control level being achieved 'by the lignite facilities' is still not that which could be achieved if ACI were used to its fullest extent." 76 Fed. Reg. at 25,046. EPA made the technical, engineering judgment that lignite-fired units should be able to achieve the same emissions levels being achieved by the bestperforming lignite unit using ACI technology, albeit at emissions levels higher than those achieved by other coal-fired

floor on what is actually achieved, Congress has already included legally permissible cost considerations in the establishment of the standard.[97]

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units. 76 Fed. Reg. at 25,046-25,047. This ACI plus fabric filter technology is not only available and in use today, but was in use and well established in 2005, when EPA illegally attempted to delist EGUs and regulate their mercury emissions under section 111. *See* NESCAUM Comments on Finding Revision at 9-11. EPA further conducted a cost effectiveness analysis and determined that the cost per pound of mercury removed from lignite units, based on fuel switching and ACI, was estimated to average $22,496 per pound of mercury removed, and that there were no nonair quality health costs. *See* EPA, "Emissions Reduction Costs for the Beyond-the-Floor Mercury Rate in the Toxics Rule," at 2 (May 3, 2011), EPA-HQ-OAR-2009-0234-2925. This beyond-the-floor determination of what constitutes MACT for mercury emissions from lignite units was well within EPA's discretion.

[97] Contrary to the implications raised in the Congressional testimony of the U.S. Chamber of Commerce, (*see* "Regulatory Chaos: Finding Legislative Solutions to Benefit Jobs and the Economy," Hearing Before the Subcomm. on Environment and the Economy of the H. Comm. on Energy and Commerce, 112th Cong. (2011) (statement of William Kovaces, U.S. Chamber of Commerce)), no section of the Clean Air Act requires a benefit-cost analysis of rules under section 112 of the Clean Air Act. Section 317 of the Act requires an economic impact of rules adopted under some sections of the Act, but *not* section 112. *See* 42 U.S.C. § 7617(a). Also contrary to the implication raised by this testimony, no legislative fix is needed, because EPA has conducted detailed economic and jobs analyses and has consistently adopted cost effective regulations stimulating the economy. Section 312 of the Clean Air Act required an economic analysis of *all* Clean Air Act programs and certain updates. *Id.* § 7612. The latest update of that report, completed just last March, found that the annual benefits of rules adopted under the Clean Air Act will equal $2 trillion annually in 2020, approximately 30 times the annual costs of those rules. EPA,

[Page 41]

Because EPA has established limitations based upon the Congressionally-mandated MACT processes of sections 112(d)(2) and 112(d)(3), both benefit-cost analysis and the requirements of the executive orders are irrelevant to the standard setting process. The requirements of Executive Order 13,563 and its predecessors apply only "to the extent permitted by law."[98] Here, the controlling provisions of the Clean Air Act dictate the process.

3.2 EPA Has Properly Determined That The Benefits Of The Proposed Toxics Rule Will Far Exceed Its Costs.

Assuming the benefit-cost analysis provisions of the executive orders were relevant to the Toxics Rule, the proposed Toxics Rule fully complies with all requirements of those orders because EPA properly and conservatively determined that the benefits of the Rule that EPA monetized will exceed all costs by a factor of at least five and will generate both economic and job growth. EPA conservatively determined that the proposed Rule would produce annual marginal benefits beyond the "base case" of

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"The Benefits & Costs of the Clean Air Act: 1990 to 2020, Summary Report," at 2 (March 2011), *available at* http://www.epa.gov/air/sect812/feb11/summaryreport.pdf. This report and the analyses accompanying the Toxics Rule confirm that there is no need for a legislative fix and that delaying the Rule would simply be bad economic, environmental, and health policy, harming the majority for the benefit of a few.

[98] *See* Exec. Order No. 13,563, § 1(b), 76 Fed. Reg. 3821; Exec. Order No. 13,422, 72 Fed. Reg. 2763; Exec. Order No. 13,258, 67 Fed. Reg. 9385; Exec. Order No. 12,866, 58 Fed. Reg. 51,735.

between $53 and $140 billion.[99] EPA further determined that the annual marginal private and societal costs of implementing the Rule would be $10.9 billion in 2015, so that the benefits produced by the proposed Rule will be 4.9 to 12.8 times greater than its costs.[100] EPA further determined that the Rule would produce 30,900 jobs during the compliance period and, on average, would produce 9,000 long term jobs (but with a possible range of 17,000 to +35,000).[101] Dr. Cicchetti has peer reviewed EPA's methodology and conclusions and has concluded that they are based on sound, scientific principles endorsed by EPA's Science Advisory Board ("SAB").[102]

[Page 42]

Both EPA's own analysis and that conducted by Dr. Cicchetti suggest that EPA's economic analysis was likely unduly conservative, in that it undervalued benefits and overvalued costs. EPA correctly concluded that the Rule would produce substantial additional benefits that it was unable to quantify.[103] Moreover, if energy efficiency policies should be implemented, costs would be reduced by $2.3 billion.[104] Dr. Cicchetti conducted additional

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[99] RIA at 1-2.

[100] RIA at 1-11.

[101] RIA at 1-12.

[102] Cicchetti Report at 4, 10-22.

[103] RIA at 1-8.

[104] EPA's analysis indicated that implementation of energy efficiency would reduce costs by $2.3 billion, with many of those reductions applicable to the base case, and between $0.3 and $1.1 billion applicable to the marginal Toxics Rule costs.

analysis to monetize additional benefits and to quantify the stimulative impact of the proposed Rule's health benefits on jobs and the economy, and determined that EPA's analysis significantly understated benefits, economic growth and job benefits.[105] In light of the clear economic and health benefits that will be achieved, expeditious implementation of the proposed Rule by 2015 is both consistent with the intent of the executive orders and is eminently sensible. This economic analysis further militates towards adoption and implementation of the proposed Rule without delay.

(a) *EPA employed peer-reviewed and conservative methodology in preparing the benefit-cost analysis supporting the Toxics Rule.*

EPA properly and conservatively calculated marginal costs and marginal benefits, using SAB approved methodology set forth in EPA's latest "Guidelines for Preparing Economic Analyses"[106] and "Guidance to Federal Agencies on Preparation of Regulatory Analysis."[107] Dr. Cicchetti found that "EPA's models, methods, sensitivity analyses, and data meet and surpass the professional and scientific

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[105] *See* Cicchetti Report at 4-5, 30-50.

[106] "Guidelines for Preparing Economic Analyses" EPA 240-R-10-001 (December 2010) ("Guidelines"), *available at* http://yosemite.epa.gov/ee/epa/eed.nsf/pages/Guidelines.html/$file/Guidelines.pdf.

[107] OMB Circular A-4, "Guidance to Federal Agencies on Preparation of Regulatory Analysis" (2003) ("OMB Guidance"), *available at* http://www.whitehouse.gov/sites/default/files/omb/assets/regulatory_matters_pdf/a-4.pdf.

requirements of independent peer review."[108] Dr. Cicchetti has conducted a "comprehensive review" of EPA's calculation of the benefits and co-benefits that EPA monetized and concluded that EPA's "net benefit methodology for valuing annual mortality and morbidity health and welfare benefits is reasonable and conservative."[109]

[Page 43]

In its analysis, EPA appropriately analyzed a "base case" representing conditions without the proposed Rule and calculated both the marginal costs and the marginal benefits.[110] This was significant, since the CSAPR, state laws, and a number of existing enforcement actions will require installation of control equipment even if the Toxics Rule were not adopted. Similarly, even without the Toxics Rule, the stabilization and reduction of natural gas prices, due to development of abundant, domestic natural gas supplies, will result in the closure of obsolete coal plants and their replacement with either new gas-fired plants or expanded use of existing gas-fired plants.[111]

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[108] Cicchetti Report at 12.

[109] *Id.* at 20.

[110] *See* Guidelines at 5-1 (Baseline); OMB Guidance at 15.

[111] For example, in EPA's base case, 174 GW of wet FGD will be installed *without* the Toxics Rule, so that implementation of the proposed Toxics Rule will result in the construction of only one additional GW of wet FGD. RIA at 8-14, fig. 8-6. Similarly, in the base case, there will be a net decrease of 8 GW of pulverized coal capacity *without* the Toxics Rule and implementation of the proposed Toxics Rule will result in an additional 10 GW of retirements, *id.* at 8-18, tbl. 8-9, most of which are comprised of

Those opposed to the Rule have raised a number of arguments against EPA's benefit-cost analysis that can only be characterized as red herrings. The opponents' arguments are certainly not based on the law, science or sound principles of economic impact analysis. Some criticisms arise from the fact that the majority of the monetized benefits attributed to the proposed Toxics Rule are identified as "co-benefits" of the rule. These "co-benefits" arise from the fact that actions taken to comply with the proposed Toxics Rule will result in reductions of $PM_{2.5}$ that will reduce premature mortality. Critics of EPA's methodology contend that these benefits should not be considered because they arise from reductions of a conventional pollutant – $PM_{2.5}$ – and not the HAPs regulated under section 112.[112] This contention is unfounded in science, law or economics. This criticism not only lacks foundation but is, in fact, inconsistent with science. The $PM_{2.5}$ fraction includes regulated HAP heavy metals and HAP acid gas aerosols, as well as non-HAP particles and aerosols. HAPs that are smaller than 2.5 microns (*i.e.* $PM_{2.5}$) have an enhanced toxicity because particles of that

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small, underutilized, ancient facilities, *id.* at 8-17, tbl. 8-8. The units projected to retire have an average age of 51 years (predating the enactment of the Clean Air Act by 10 years) as compared to an average age of 44 years for remaining units, an average capacity of 109 MW compared to 278 MW for operational units, and an average capacity factor of 56% compared to 71% for operational units. *Id.*

[112] This criticism was raised in EPA's public hearing on the Toxics Rule by a group that has named itself the "Electric Reliability Coordinating Council." The group has no information on its website regarding membership and certainly does not speak for Exelon or any of the other electric utilities who are members of the Clean Energy Group.

size can go deep into the lungs.[113] EPA initially listed

[Page 44]
$PM_{2.5}$ as a criteria pollutant under section 108 of the Clean Air Act because, among other reasons, that particulate fraction includes heavy metals and toxic particles that damage the lungs when deeply inhaled.[114] In addition, the acid gas aerosols that are not regulated HAPs will have synergistic and additive effects with the HAPs, so that the beneficial effects of removing both HAPs and non-HAPs in that fraction cannot be segregated.[115]

Any criticism based on the notion that it was improper to consider the benefits of $PM_{2.5}$ reductions can also only be based on a fundamental misunderstanding of benefit-cost analysis. A properly executed benefit-cost analysis examines all of the marginal costs and benefits that will be caused by implementation of the Rule, regardless of whether they are the intended or mandatory benefits or co-benefits.[116] Even assuming one could separate the benefits of reducing non-HAP fine particulates from HAP fine particulates, it would be inappropriate to

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[113] "National Ambient Air Quality Standards for Particulate Matter; Final Rule," 62 Fed. Reg. 38,652, 38,666-38.668 (July 18, 1997).

[114] *Id.* (*see* references to transition metals and acid aerosols generally).

[115] Acids act as inflammatory agents because, when dissolved in water, they dissociate into H+ and a base ion, so that impacts of acid emissions are additive (although not in a linear relationship).

[116] *See* Cicchetti Report at 4, 10-12, 19-20.

fail to include the benefits of the non-HAP pollutant reductions. These reductions will be the direct result of implementation of the proposed Rule and are properly counted as direct benefits of the Rule. To suggest that they should be segregated would be the equivalent of a lead mining and smelting company, in its consideration of whether it would be cost effective to mine a vein of mixed lead and silver, excluding the value of the silver because it is a lead company and the mine is intended to supply its lead smelter. [117]

A second criticism of EPA's benefit-cost analysis is founded on the argument that the costs and benefits of the Toxics Rule should be considered together with the costs and benefits of all of the pending EPA rules for power plants. While there are instances where it may be appropriate to consider "linked rules" together, that is impossible in the case of the various regulations affecting the utility industry. Delays in meeting statutory rulemaking deadlines and the illegal attempts by the last Administration to avoid statutory requirements, such as promulgating the Clean Air Mercury Rule, have resulted in court orders and settlements with strict deadlines that effectively prevent EPA from coordinating the rules and considering them together. In this case, considering the marginal impact of each rule *seriatim* is appropriate. [118] EPA has not double counted either benefits or costs but

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[117] *See id.* at 19-20.

[118] Guidelines at 5-12.

has considered only the marginal effects of the Toxics Rule. This is the appropriate benefit-cost analysis. [119]

[Page 45]

(b) *EPA overestimated costs and underestimated benefits.*

The ratio of the value of the annual benefits generated by the Toxics Rule to its annual costs is significantly higher than estimated by EPA, because the agency has overestimated the likely costs of compliance and has failed to include many benefits which the agency either did not or could not adequately monetize. There is a consistent pattern of overestimating costs and underestimating benefits of major environmental regulations. [120] Costs are often overestimated, *ex ante*, in part due to technological innovation, and benefits are usually underestimated due in part to the difficulty in measuring many benefits, the lack of complete knowledge of health impacts, and the failure to consider economic stimulative effects. [121] For example, according to one source, phasing out lead in gasoline ultimately cost 95% *less* than the *ex ante* estimates due, in part, to technological innovation, while new research on impacts of lead on children has shown that its benefits were five times as great as the *ex ante*

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[119] *See* Cicchetti Report at 4, 11-12, 20-21 (EPA properly established baseline conditions and calculated marginal impacts).

[120] *See* Robert V. Percival, "Regulatory Evolution and the Future of Environmental Policy," 1997 U. Chi. Legal F. 159, 176-184 (1997); *see also,* Cicchetti Report at 33-35.

[121] Percival, 1997 U. Chi. Legal F. at 176-184.

estimates.[122] According to the RIA, the costs of implementing the acid rain program were 83% lower than original estimates.[123]

EPA significantly underestimated the benefits of the proposed Toxics Rule simply because the Agency failed to monetize many of the benefits that will arise from the proposed Rule. This was not because these benefits are insignificant. Rather, EPA could establish that just some of the benefits of the proposed Rule will vastly outweigh all of its costs based on available peer-reviewed studies, and pursuing additional analysis to monetize additional benefits would have only "gilded the lily" while delaying implementation of the Rule and its enormous net benefits.[124] The benefits that EPA did not monetize include the benefits: (1) to young women who now avoid eating fish due to concerns of mercury; (2) arising from reductions in synergistic and additive effects of the pollutants whose emissions will be reduced; (3) of enhanced ecosystem services; (4) of reduced acidification of ecosystems; (5) of the elimination or reduction of a variety of unquantified health impacts, including respiratory effects resulting in increased hospital and emergency room visits, respiratory symptoms, airway hyperresponsiveness, airway inflammation and lung function; and (6) of reduction of impacts of heavy metals. EPA also failed to monetize secondary

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[122] *Id.* at 181-182.

[123] *See* Cicchetti Report at 33 (citing RIA at 8-32 to 8-33).

[124] *Id.* at 32-33.

impacts, such as the economic benefits to downwind businesses. [125]

[Page 46]

Dr. Cicchetti quantified just a few of the additional benefits. He examined the implicit "tax" on downwind businesses that arises from increased health insurance and labor costs that accompany the adverse health impacts of the pollutants that will be removed as a result of the Toxics Rule. Dr. Cicchetti also examined the secondary stimulatory impacts of increased jobs arising from construction of new electric generation capacity and pollution control equipment and determined that these secondary impacts would also increase GDP, with a net impact of $7.170 billion. [126] With these additions (which still leave out many of the unmonetized benefits noted above), the total annual monetized benefits of the Air Toxics Rule range from $52.5 billion to $139.5 billion. The Toxics Rule will also help rein in spiraling health care costs, reducing those by $4.513 billion annually. [127]

EPA's analysis also overstates the costs. Unlike the case with the Mobile Source Rule, in calculating the costs of the Toxics Rule, EPA did not provide any allowance for technological developments. [128]

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[125] *See id.* at 31-33.

[126] *Id.* at 5.

[127] *Id.*

[128] *See* "Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule," 75 Fed. Reg. 25,324 (May 7, 2010); RIA at 8-12 to 8-14.

Technological innovation has routinely resulted in proposed environmental rules and legislation costing far less than EPA originally estimated.[129] This is particularly the case with the electricity industry, which according to Dr. Cicchetti, "has an uninterrupted, successful history of implementing technical improvements and reducing costs through least cost engineering principles."[130] On the other hand, EPA calculated the impact of implementing energy efficiency policies, just one aspect of innovation, but did not include that in its estimate of costs. That modeling shows that energy efficiency policies would reduce total electric system generation costs for 2015 with the Toxics Rule by $2.3 billion, reducing the cost of the base case by $2.0 billion and the Toxics Rule case by $0.3 billion. If implementation of these energy efficiency measures is attributed to incentives produced by the Toxics Rule alone, the net costs would be reduced by $2.3 billion (for a net cost of $8.6 billion) and if one looks only at the marginal costs assuming that energy efficiency measures would be implemented even without the Toxics Rule, the marginal cost would be reduced to $10.5 billion.[131]

The results of the most recent PJM capacity auction, which include consideration of the likely impact of the Air Toxics Rule, confirm Dr. Cicchetti's statements regarding the ability of the electricity industry to innovate and the likely effect of measures

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[129] *See* Percival, 1997 U. Chi. Legal F. at 178-179; Cicchetti Report at 33-35.

[130] Cicchetti Report at 33.

[131] *See* RIA at 8-28 to 8-29, tbl. 8-16.

to improve energy efficiency. While approximately 6.9 fewer GW of ancient coal-fired capacity cleared the auction (1.85 fewer GW were offered), an additional 4.836 GW of demand response (energy efficiency)

[Page 47]
resources cleared the auction, mitigating the impacts of retirements or increased costs for coalfired plants on consumer prices.[132] This is also reflected by Exelon's analysis in its 2020 Plan, which shows nuclear uprates, energy efficiency and coal retirements can reduce emissions of carbon dioxide and all fossil fuel-fired pollutants at a negative cost per ton of pollutant removed while providing adequate electric capacity, and that additional low pollution energy resources in the form of coal to gas conversions, energy efficiency, new gas-fired plants, and nuclear uprates can produce additional carbon dioxide and other pollution reductions at a very reasonable price.[133]

Thus, considering only the additional monetized benefits calculated by Dr. Cicchetti and the impacts of innovations in energy efficiency, benefits are 7 to 17 times greater than costs. Net benefits range from $52.5 billion to $139.5 billion annually.[134] These ratios underscore the importance of: (1) promulgating the proposed Rule as soon as practicable and no later than required under the

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[132] "Up in Smoke."

[133] *See* Exelon 2020: 2010 Update (attached hereto as Exhibit 22).

[134] Cicchetti Report at 5.

settlement agreement, and (2) strictly adhering to the Clean Air Act's three year implementation deadline with minimal extensions of time to comply.

3.3 The Proposed Toxics Rule Will Generate Increased Jobs And Spur Economic Growth.

The economic impact analysis in the RIA also significantly underestimated the positive impact of the proposed Toxics Rule on job growth and GDP.[135] EPA estimated that "[o]verall, the results suggest that the proposed rule could support a net of roughly 31,000 jobyears in direct employment impacts in 2015[,]" mostly as a result of impacts of additional jobs created to build new generation capacity and new control technology.[136] In addition, EPA predicted an average long term increase of 9,000 jobs "in the directly affected [utility] sector," although it found that this impact could range from a loss of 17,000 to an addition of 35,000 jobs.[137] This analysis does not account for the significant stimulative impacts of the health improvements resulting from the Toxics Rule or the downstream impacts of those improvements. The RIA's analysis is also unduly conservative because it assumes that the economy is at full employment and, therefore, fails to account fully for the fact that the construction required to

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[135] Section 321 of the Clean Air Act requires EPA to evaluate the impacts of its programs on employment. 42 U.S.C. § 7621.

[136] 76 Fed. Reg. at 25,076; RIA at 9-15.

[137] RIA at 9-8, 9-15.

[Page 48]
comply with the Toxics Rule will generate income and spending that will further stimulate the economy "downstream" and thereby generate additional jobs. [138]

Dr. Cicchetti's analysis indicates that EPA's estimates in the RIA are significantly low. With respect to jobs created as a result of construction of air pollution control equipment and new generation capacity, he estimates that if indirect jobs were added, "the employment effects would more accurately equal 61,355." [139] Moreover, if EPA had not assumed full employment at a time when unemployment is persistently stuck close to 10%, Dr. Cicchetti estimates that the correct figure for increased jobs would be 107,190, almost three times EPA's estimate. [140] This would add over $6 billion to GDP. [141]

Dr. Cicchetti has also calculated that, by reducing costs for downwind businesses, the health improvements resulting from the Toxics Rule will create 8,330 new jobs, increase GDP by $1.099 billion, and increase tax revenues by $412 million. [142] Accounting for this additional job creation doubles the average long-term job creation, without considering either secondary impacts or the impacts of the increased construction. When the latter two

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[138] Cicchetti Report at 47-48.

[139] *Id.* at 46-47.

[140] *Id.* at 47.

[141] *Id.*

[142] *Id.* at 42-43, tbl. 5.

factors are considered together and added to EPA's calculated benefits, Dr. Cicchetti estimates that the Toxics Rule will create 115,520 jobs, increase net annual GDP by $7.170 billion, and generate $2.689 billion in additional annual tax revenues. In addition to these benefits, the Rule will generate $4.513 billion in annual health care savings.[143] In this time of rising health care costs, rising deficits, and weak growth in jobs and GDP, the nation cannot afford to delay implementation of this Rule.

Dr. Cicchetti's conclusions regarding the positive impacts of the Toxics Rule and its stimulative impacts are further supported by a study conducted by Dr. Josh Bivens of the Economic Policy Institute, who also found that EPA's conclusions were conservative.[144] Dr. Bivens concluded:

> The EPA RIA on the proposed toxics rule makes a compelling case that the rule passes any reasonable cost-benefit analysis with flying

[Page 49]

> colors—the monetized benefits of longer lives, better health, and greater productivity dwarf the projected costs of compliance. . .
>
> Whether regulation in general and the toxics rule in particular costs jobs is an empirical

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[143] *Id.* at 5.

[144] Josh Bivens, "A Lifesaver, Not a Job Killer: EPA's proposed "air toxics rule" is no threat to job growth," EPI Briefing Paper #312 (June 14, 2011), *available at* http://w3.epidata.org/temp2011/BriefingPaper312%20%282%29.pdf.

> question this paper attempts to answer. In particular, this paper examines the possible channels through which the proposed toxics rule could affect employment in the United States and finds that claims that this regulation destroys jobs are flat wrong: The jobs-impact of the rule will be modest, but it will be *positive*.[145]

Without even considering the positive jobs impact on downstream businesses arising from the health improvements, Dr. Bivens also finds that the Toxics Rule will create more jobs than calculated in the RIA. His report details the following major findings:

- The [Toxics Rule] would have a modest positive net impact on overall employment, likely leading to the creation of 28,000 to 158,000 jobs between now and 2015. (This estimate reflects the specific findings that follow below.)

- The employment effect of the [Toxics Rule] on the utility industry itself could range from 17,000 jobs lost to 35,000 jobs gained.

- The [Toxics Rule] would create between 81,000 and 101,000 jobs in the pollution abatement and control industry (which includes suppliers such as steelmakers).

- Between 31,000 and 46,000 jobs would be lost due to higher energy prices leading to reductions in output.

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[145] *Id.* at 16.

- Assuming a re-spending multiplier of 0.5, and since the net impact of the above impacts is positive, another 9,000 to 53,000 jobs would be created through respending. [146]

While the positive impact of the Toxics Rule on job growth will be modest, the combined impact of CSAPR and the Toxics Rule on job growth will be enormous. The University of Massachusetts Political Economy Research Institute prepared a February 2011 study of the jobs impacts of the two rules arising from the investments required by the utility industry in the 36 states of the Eastern Interconnection. Based on estimates that the power sector will invest almost $200 billion total in capital improvements between 2010 and 2015 in these 36 states, the researchers found that the total employment created by these capital investments is estimated at 1.46 million jobs, or about 290,000 jobs on average in each of those years. [147]

[Page 50]

Thus, multiple researchers have confirmed that (1) EPA's estimates of job creation and economic stimulus are conservative, and (2) the Toxics Rule will stimulate growth in jobs that the nation's economy needs. These rules are not only good environmental policy, but good jobs and economic policy.

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[146] *Id.* at 2.

[147] PERI Report at 2.

3.4 The Proposed Toxics Rule Will Induce Investment In A Modern Generation Fleet That Will Provide The Basis For Long Term Economic Health For The Nation And The Industry.

Implementation of the Toxics Rule will promote long-term economic health for both the utility industry and the nation as a whole by encouraging investment in a modern, efficient generation fleet. It is well recognized that the perverse incentives created by the Clean Air Act's new source review program, the many legislative exemptions applicable to coal-fired power plants, and political pressures against investment in states where electricity generation is regulated, together have depressed investment in modern generation technology and thereby preserved an antiquated, inefficient coal-fired fleet that transfers its costs to downwind and unborn populations. By causing that fleet at long last to internalize some of those costs, the Toxics Rule will encourage investments in other, more modern, low-pollution generation technologies. These include upgrades to existing nuclear plants that can improve zero-pollution nuclear generation capacity by several gigawatts, investments in alternative, renewable technologies, investments in co-generation and energy efficiency, and investments in new, combined cycle gas-fired plants, modern, conventional coal-fired plants and, if cost effective, coal gasification combined cycle plants [148]

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[148] *See* Cicchetti Report at 34-38.

The expected impact of the Toxics Rule and other EPA regulations has already created market conditions to enable Exelon to embark on a program to invest nearly $5 billion in cost-effective, clean energy projects. The projects in Illinois, Pennsylvania and other states include energy-efficiency and Smart Grid programs, economic renewable energy investments, and increased output at Exelon's nuclear plants achieved through Exelon's uprate program. These programs will effectively increase reliable electric generation that produces no toxic pollutants, conventional pollutants, or greenhouse gases. Other companies can make similar cost-effective, zero pollution investments with the market conditions fostered by the Toxics Rule.

The development of technology for recovery of abundant, domestic shale gas resources creates further opportunities for industry to modernize, reduce pollution, and increase efficiency cost effectively, using domestic energy resources.[149] Combined cycle gas plants allow a much more efficient use of the heat content of fossil fuels. Moreover, the antiquated coal-fired plants that will retire are the smallest, most polluting and least efficient element of the nation's generation fleet. Fifty-nine percent of the coal-fired units in operation today were in existence when the Clean Air Act was enacted in 1970, and 61% of those units lack both controls for NO_x

[Page 51]

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[149] *See id.* at 35-36.

and scrubbers to control SO_2 and other acid gases.[150] These ancient coal units are small, with an average nameplate capacity of 168 MW,[151] and have a low utilization rate, producing only a tiny fraction of the United States' electricity.[152] Indeed, the unused capacity in the Nation's fleet of clean, combined cycle gas-fired plants, alone, is 18% greater than the total capacity of these ancient coal-fired plants, which are the least utilized segment of the coal-fired fleet.[153] Closure of the small, antiquated units will improve the health of the economy and the electric generation industry by making investment in newer, more efficient, more reliable plants worthwhile. These newer plants will improve long term economic efficiency, while improving health and the environment.

3.5 The Toxics Rule Applies A Sensible Sectorwide Regulatory Approach That Will Produce Net Benefits And Promote Long Term Economic Growth In Full Compliance With Executive Order 13563.

As is evident from the foregoing and the Cicchetti Report, by producing benefits far exceeding its costs and promoting both economic and job

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[150] M.J. Bradley Report at 19-20, tbl. 5

[151] *Id.*

[152] In 2008, coal-fired units with a nameplate capacity of less than 200 MW had a 45% capacity factor, as compared to a 67% capacity factor for units larger than 500 MW, and produced only approximately 3.4% of the electricity produced by coal and 1.5% of the total electricity produced in the United States. *See* M.J. Bradley Report at 7, 13, tbl. 4.

[153] *See* M.J. Bradley Report at tbls. 4&5; *see also* TPH Report.

growth, the Toxics Rule will fully comply with both the letter and intent of Executive Order 13,563 and prior executive orders, while satisfying the minimum requirements of section 112 of the Clean Air Act. Executive Order 13,563 requires that:

> to the extent permitted by law, each agency must, among other things: (1) propose or adopt a regulation only upon a reasoned determination that its benefits justify its costs (recognizing that some benefits and costs are difficult to quantify); (2) tailor its regulations to impose the least burden on society, consistent with obtaining regulatory objectives, taking into account, among other things, and to the extent practicable, the costs of cumulative regulations; (3) select, in choosing among alternative regulatory approaches, those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity); (4) to the extent feasible, specify performance objectives, rather than specifying the behavior or manner of compliance that regulated entities must adopt; and (5) identify and assess available alternatives to direct regulation, including providing economic

[Page 52]

> incentives to encourage the desired behavior, such as user fees or marketable permits, or providing information upon which choices can be made by the public.

Exec. Order 13,563, 76 Fed. Reg. 3821. These requirements are satisfied, despite the constraints created by the requirements of section 112.

Both EPA's and Dr. Cicchetti's analyses show that benefits of the Toxics Rule far exceed its costs and justify its adoption under the standard set forth in this Executive Order. The Toxics Rule also will generate increased employment and economic growth, in part by requiring new construction and in part by reducing the implicit tax imposed on downwind businesses in the form of additional health costs. EPA has also complied with the other requirements of the Executive Order, by involving the public, employing where it can flexible approaches such as averaging, establishing performance based standards (*i.e.*, emissions standards), and relying on sound objective science.

In particular, EPA has satisfied the requirements of section 3 of the Executive Order, requiring coordination and harmonization of regulatory actions and the promotion of innovation. EPA's efforts to harmonize its many actions applicable to the utility industry is evident from the fact that, in the reliability modeling conducted for the EEI, the proposed Toxics Rule is the alternative, less burdensome "Alt Air Case" and the recently proposed 316(b) cooling water intake regulation, 76 Fed. Reg. 22,174 (Apr. 20, 2011), is the alternative,

less burdensome "Alt Water Case." [154] The EEI report did not model the impacts of the alternative air and alternative water scenarios together, suggesting that EPA has harmonized the rules to minimize impact on the industry far beyond industry's expectations. [155] Harmonization is also evident from the fact that the IPM modeling shows that compliance with the proposed Toxics Rule will require the construction of only one additional GW of wet FGD, in addition to the 174 GW that will be constructed in the Base Case. This suggests that the pollution control technology required for the CSAPR and other regulatory requirements will enable most facilities to meet the most capital intensive requirements of the Toxics Rule, with no additional capital investment. [156]

Most importantly, in compliance with section 3 of the Executive Order, the proposed Toxics Rule will promote innovation and create incentives to modernize the generation fleet, making the electric generation industry and the American economy stronger and more kresilient. The Rule will lead to the closure of many of the ancient, inefficient coal-fired power plants whose artificially low prices are deterring investments in clean generation and demand management technologies. These plants have been kept alive and their modernization has

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[154] *See* Steven Fine, Shanyn Fitzgerald, & Jesse Ingram, ICF International, "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet," prepared for Edison Electric Institute (Jan. 2011).

[155] *See* Tierney-Cicchetti Peer Review Report.

[156] *See* RIA at 8-14.

been inhibited by the perverse incentives created by the Clean Air Act new source review program.

[Page 53]
where modernization has not been deemed cost-effective because it would require the installation of emissions controls now required of existing plants. By requiring installation of controls that will lead to the long overdue modernization, or closure and replacement, of these ancient facilities, the Toxics Rule will clear the tracks for the clean energy economy of the future.

3.6 There Is No Reason To Create A Special Status For Small Entities That Are Operating Inefficient, Uncontrolled Units And Transferring Costs To Downwind Small Businesses And Communities.

Some parties, including the Small Business Administration ("SBA"), have raised concerns that the Toxics Rule will impose undue burdens on small entities, including municipalities, who operate small, obsolete coal-fired units that will be forced to upgrade or to close. *See* 76 Fed. Reg. at 25,083-25,087. There is no legal or factual basis for creating subcategories or weaker standards for state, tribal, or municipal governments or small entities who are operating obsolete units, particularly given the current market situation and applicable equitable factors. Many of these small entities own shares of larger facilities along with larger entities. The relaxation the SBA seeks would not only harm downwind governments and small businesses who incur higher labor costs due to pollution, but will harm other small businesses and state, tribal and

local governments developing or operating generation facilities using modern and less polluting generation technologies. The SBA's position would simply favor one segment of the small business sector over others. In fact, its position undermines the intent of the Small Business Regulatory Enforcement Fairness Act ("SBREFA"), 5 U.S.C. § 601 *et seq.*, by harming the very segments of small business most likely to generate economic growth and the new jobs associated with that growth.

There is also nothing in the Unfunded Mandates Reform Act ("UMRA"), 2 U.S.C. §§ 658-658g, 1501-1571, that requires any preferential treatment for state, tribal or municipal government entities who will be required to expend funds to comply with the Toxics Rule because they are operating obsolete units. Rather, section 202 of the UMRA, 2 U.S.C. § 1532(a), sets forth a process that EPA must follow for any proposed or final rule that "includes any Federal mandate that may result in the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector, of $100,000,000 or more in any one year." This process requires EPA to identify and consider a reasonable number of regulatory alternatives and to adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. Section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective or least burdensome alternative if the Administrator publishes an explanation why that alternative was not adopted. 2 U.S.C. § 1535(b). There is nothing in the statute that requires EPA to save costs to one sector of the economy at the expense of another sector.

Both EPA's and SBA's analyses suffer from tunnel vision, in that they focus exclusively on the effects on entities causing HAP emissions and primarily on those operating obsolete EGUs, and fail to consider either impacts on downwind businesses and governments or the positive impacts on small entities and governments owning and operating competing, clean and modern EGUs. In proposing the Toxics Rule, EPA found that, while there will be significant monetary impacts on state, local and tribal governments, two-thirds of those costs were lost profits due to retirements. The coal- and oil-fired EGUs that will retire are largely old, small, inefficient, and uncontrolled units. These units are generating profits for the governments

[Page 54]
and small entities that own them and potentially reducing electric prices for their customers at a significant cost to downwind populations and economies, including many governments and small businesses that face higher health care costs as a result of the toxic emissions. Neither EPA's analysis nor SBA's comments consider those downwind costs. Dr. Cicchetti's analysis shows that the costs being incurred by small businesses and governments as a result of the emissions from these units are substantial.[157] Indeed, these downwind emissions are causing state, local and tribal governments to incur additional health care and employee

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[157] *See* Cicchetti Report at 38-44.

expenses,[158] so that failing to limit these emissions might be considered an unfunded mandate.

These antiquated facilities are also harming the many small businesses and governments who have invested in clean generation technologies by depressing prices in competitive electric generation markets. Many small businesses and local governments have developed modern cogeneration and alternative energy facilities, sometimes alone or in publicprivate partnerships. Many of these businesses are small start-ups. The existence of older, fully depreciated, and uncontrolled or poorly controlled coal-fired units adversely affects the profitability of these modern, efficient projects by depressing both capacity and electricity markets. Relaxing standards for the older facilities would, therefore, benefit neither government entities nor small businesses, but would merely create a benefit for those owning older, outdated technology at a cost to those implementing newer or more innovative technologies.

Neither the UMRA nor the SBREFA dictates such a nonsensical result. By requiring consideration of impacts on small businesses and a regulatory flexibility analysis, Congress did not intend to create a favored status for the manufacturers of buggy whips, merely because they are small or governmental entities, while undermining the interests of other small businesses and governments. In enacting the SBREFA, Congress found that "a vibrant and growing small business sector is critical

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158 *Id.*

to creating jobs in a dynamic economy." Pub. L. No. 104–121, 110 Stat. 857–862, as amended by Pub. L. No. 110–28, 121 Stat. 204, *reprinted in* 5 U.S.C. app. § 601. The position taken by SBA would turn this on its head by undermining the very businesses that will create new jobs and economic growth.

4. ELECTRICITY PRICES IN MOST AREAS WILL BE THE SAME OR LOWER WHEN THE TOXICS RULE TAKES EFFECT IN 2015 THAN THEY WERE IN 2010.

Claims that the Toxics Rule will cause increases in electricity rates that will adversely affect the Nation's economy also lack foundation. To the contrary, Exelon's analysis of the Rule's impact in its service areas indicates that electricity generation charges to its customers will be lower when the Rule takes effect in 2015 than in 2010. Declining natural gas prices due to low-cost, abundant natural gas supplies, together with load management alternatives such as energy efficiency and demand response, will also prevent increases in electricity prices by significantly lowering the cost of reducing harmful air toxics. Wholesale power market prices have demonstrated a recent downward trend driven primarily by lower

[Page 55]
natural gas prices and reduced demand. Most experts agree that natural gas prices will likely remain low for many years, and any rate increases from EPA compliance will occur while lower fuel costs continue to place downward pressure on utility rates. Accordingly, although the Toxics Rule and other EPA rules will offset this downward pressure

and sustain wholesale prices that will support continued investment in a clean and reliable energy generation supply, consumer retail generation prices in Exelon's markets will remain relatively stable.

Exelon retained The NorthBridge Group ("NorthBridge") to estimate the potential rate impact resulting from the Toxics Rule on its customers in both the ComEd and PECO service territories. NorthBridge concluded that, based on current market conditions (which may change), generation rates in 2015 will be *less* than 2010 levels on an inflation-adjusted basis.[159] NorthBridge reports that this finding is in large part due to the significant decline in natural gas prices in recent years. Exelon's customers will benefit from lower gas prices, and this price decline will mitigate any potential rate increases related to the Toxics Rule. The results of NorthBridge's analysis are set forth in Figure 1.

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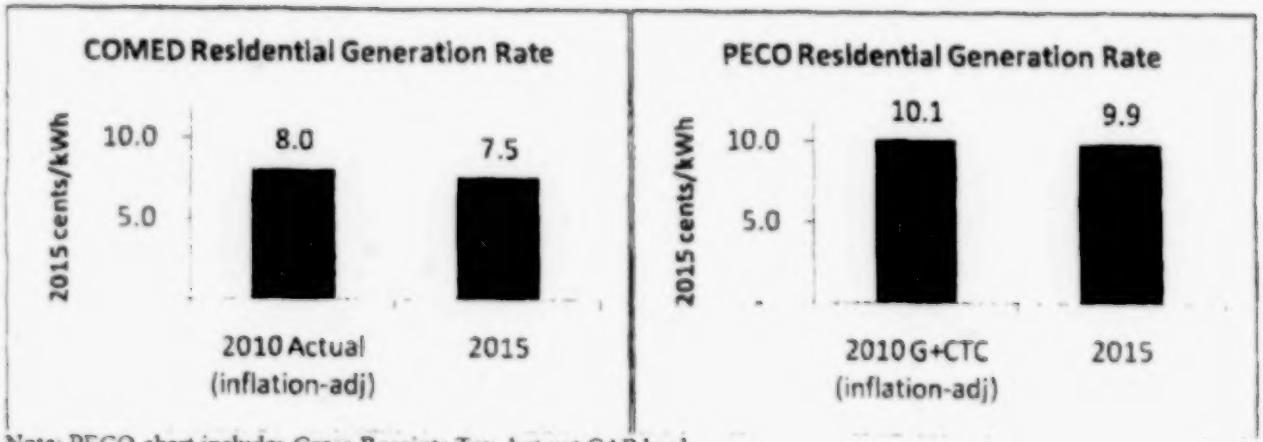
[159] NorthBridge analyzed generation rates because generation has been deregulated in both Pennsylvania and Illinois and is billed as a separate line item directly to retail customers.

[Page 55 cont.]



Note: PECO chart includes Gross Receipts Tax, but not CAP load.

[Page 55 cont.]

In the ComEd service area, generation rates in 2010 were based on the blended price of purchases by ComEd and the Illinois Power Authority during the 2006 to 2010 period. Many of these contracts were executed during a time when natural gas and power prices were higher than today. The resulting residential generation rate was 7.2 cents per kilowatt hour ("kWh") in 2010, which translates to 8.0 cents per kWh in 2015 dollars, assuming 2 percent annual inflation. Based on current market prices in ComEd for 2015, the projected ComEd residential generation rate is 7.5 cents per kWh, which is 6 percent *lower* than the inflation adjusted 2010 level. The current market prices for 2015 implicitly include the projected impact of retirements arising from EPA rules, variable cost changes, and gas price increases.

In the PECO service area, generation rates in 2010 were based on the prices established as part of Pennsylvania electricity restructuring. The resulting residential generation

[Page 56]

rate totaled 9.1 cents per kWh in 2010,[160] which translates to 10.1 cents per kWh in 2015 dollars assuming a 2 percent inflation rate. Based on current market prices in PECO for 2015, the

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[160] Under Pennsylvania's transition program, rates were capped in the PECO service area through 2010 but a variety of other charges related to generation were included separately on customer electricity bills. The 2010 generation rate was calculated by including energy, capacity, and generation-related competition transition charges into a single charge.

projected residential generation rate is 9.9 cents per kWh, which is 2 percent lower than the inflation adjusted 2010 level.

The projected market-based residential generation rate in the PECO service area is higher than in ComEd because market prices tend to be higher in the East than in the Midwest. However, in both service territories, the projected market-based wholesale electricity price for 2015, including all impacts from the Toxics Rule and other EPA rulemaking efforts, is lower than the comparable number for 2010.

5. THE TOXICS RULE IS BOTH AUTHORIZED AND REQUIRED BY LAW.

5.1 EPA Is Obligated To Promulgate Section 112 Standards For EGUs Because EGUs Are Listed Under Section 112(c) And There Is No Evidence Upon Which EPA Could De-List Those Source Categories.

EPA is legally required to promulgate the Toxics Rule. Rather than include the utility sector as a category for which EPA initially was required to develop HAP emissions standards, section 112(n)(1) first directed EPA to conduct two studies – one study of the impacts to public health from EGU HAP emissions (the "Utility Study")[161] and a second study

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[161] EPA completed the Utility Study in February 1998, more than four years later than the November 15, 1993, deadline set by section 112(n)(1)(A). *See* EPA, "Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress," Feb. 1998, EPA-HQ-OAR-2009-0234-3052.

of the mercury emissions from EGUs and other sources and how those emissions may feasibly be controlled (the "Mercury Study")[162] – and directed the National Institute of Environmental Health Sciences to conduct a third study related to the threshold level for health effects from mercury exposure. 42 U.S.C. § 7412(n)(1). Congress *required* that EPA regulate EGUs under section 112 if regulation was appropriate and necessary after considering the results of the Utility Study. *Id.* § 7412(n)(1)(A). On December 14, 2000, EPA made the finding that regulation of HAP emissions from coal-fired and oil-fired EGUs under section 112 is appropriate and necessary ("the Finding").[163] As a result of the Finding, EPA added coal-fired and oil-fired

[Page 57]
EGUs to the list of source categories under section 112(c) of the Act.[164] Section 112 then required EPA to promulgate emission standards for those EGUs within two years of the listing – *i.e.*, by December 20, 2002. *See* 42 U.S.C. § 7412(c)(5).

The Toxics Rule has been long delayed. More than 20 years have passed since Congress amended

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[162] EPA completed the Mercury Study in December 1997, more than three years later than the November 15, 1994, deadline set by section 112(n)(1)(B). *See* EPA, "Final Mercury Study Report to Congress," Dec. 1997, EPA-HQ-OAR-2009-0234-3054.

[163] *See* "Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units," 65 Fed. Reg. 79,825 (Dec. 20, 2000).

[164] *Id.* at 79,826; *see also* 67 Fed. Reg. 6521, 6524 (Feb. 12, 2002).

section 112 with the express intent of mandating quick EPA action to establish technology-based emission standards for emissions of HAPs.[165] EPA published its Finding a full decade after Congress amended section 112, much later than reasonably anticipated under the statute; EPA had missed the statutory deadlines for the Mercury Study and the Utility Study by more than three and four years, respectively. Then, EPA missed the statutory deadline to promulgate a rule, and instead unlawfully further delayed the Toxics Rule by attempting to reverse course in 2005, and to rescind the Finding and to de-list EGUs from regulation under section 112.[166] That action was vacated in *New Jersey v. EPA*, 517 F.3d 574, 583 (D.C. Cir. 2008). As a result, the Agency has allowed EGUs to operate without the imposition of section 112 standards for many more years than Congress contemplated was appropriate.[167]

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[165] *See, e.g.*, *New Jersey v. EPA*, 517 F.3d at 583 ("Congress was not preoccupied with what EPA considers 'anomalous,' but rather with the fact that EPA had failed for decades to regulate HAPs sufficiently"); *Nat'l Lime Ass'n v. EPA*, 233 F.3d 625, 634 (D.C. Cir. 2000) ("Congress added the list of pollutants to be regulated, regulation deadlines, and minimum stringency requirements to the Clean Air Act precisely because it believed EPA had failed to regulate enough HAPs under previous air toxics provisions.").

[166] "Revisions of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- And Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List; Final Rule" 70 Fed. Reg. 15,994 (Mar. 29, 2005).

[167] The Agency's delay effectively has conferred an additional benefit upon the owners of EGUs with high HAP emissions.

[Page 58]

The court in *New Jersey* found that Congress limited EPA's discretion to reconsider its own listing decisions, and held that the Agency could not simply reverse its determination that regulating EGUs was appropriate and necessary within the meaning of section 112(n)(1).[168] Having made the Finding and listed the source category, the only way that the Agency could possibly avoid promulgating section 112 regulations for EGUs is to meet the delisting criteria set forth in section 112(c)(9). *See* 42 U.S.C. § 7412(c)(9)(B). EPA has never made such a determination, and the Agency neither does nor could do so here. To the contrary, even though it was under no obligation to do so, EPA has confirmed that

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When EPA conducted its additional analyses in this Rule with respect to whether it remains appropriate and necessary to regulate EGUs under section 112, the Agency's analysis took into consideration reductions in HAP emissions from other industrial sectors and in EGUs from non-section 112 Clean Air Act programs, that could have only been known with sufficient certainty after an extended delay in promulgating the Rule. The respite provided to these older, uncontrolled fossil fuel-fired facilities also imposed costs on those downwind from the facility, in terms of impaired health and higher employment and health care costs, as well as costs on the owners of clean electric generation capacity. Having made the Finding in 2000 that it was necessary to regulate HAP emissions from EGUs, and having now reaffirmed that Finding based upon new studies taking into account other developments in the intervening 11 years, EPA is well founded to promulgate section 112 standards for the utility industry.

[168] *New Jersey v. EPA*, 517 F.3d at 582-83 ("Congress, however, can limit an agency's discretion to reverse itself, and in section 112(c)(9) Congress did just that, unambiguously limiting EPA's discretion to remove sources, including EGUs, from the section 112(c)(1) list once they have been added to it.").

it remains appropriate and necessary to regulate coal-fired and oil-fired EGUs under section 112.

Accordingly, the Toxics Rule is required by law and is long overdue. The Agency is now obligated to establish section 112(d) standards for EGUs no later than November 16, 2011. *See Am. Nurses Ass'n v. Jackson*, 2010 U.S. Dist. LEXIS 37634 (Apr. 15, 2010) (entering the Consent Decree, published at 2009 U.S. Dist. LEXIS 129473). EPA's proposal is an important and appropriate step toward satisfying that obligation.

5.2 After *New Jersey*, The Decision To Regulate EGUs Must Be Valid If EPA Could Not De-List EGUs Under Section 112(c)(9), And The Evidence Confirms That De-Listing These Source Categories Would Be Legally Impermissible.

Having made the appropriate and necessary Finding and listed EGUs as a source category under section 112(c), the only way the Agency could possibly avoid promulgating regulations is to make the showing required by section 112(c)(9) to de-list EGUs. After *New Jersey*, the de-listing criteria provide the minimum standards for declining to regulate EGUs. That is, the Court's decision in *New Jersey* implies that it must be necessary and appropriate to regulate EGUs if EPA cannot meet the standard for de-listing set forth in section 112(c)(9). When objectors attempted to challenge the 2000 Finding, their appeal was dismissed as unripe and the Court held that the decision to list could only be challenged in the context of a challenge to the promulgation of a NESHAP. *Utility Air Regulatory*

Group v. EPA, 2001 WL 936363, No. 01-1074 (D.C. Cir. July 26, 2001). EPA's decision in 2005 to reconsider the 2000 Finding and listing and to delist EGUs was effectively a voluntary decision by EPA to reconsider its earlier determination, rather than to wait for a judicial challenge and a remand. The Court's decision in *New Jersey* invalidating that action and determining that the de-listing criteria in section 112(c) govern the Agency's voluntary reconsideration of its listing decision necessarily means that it must be proper for EPA to have listed EGUs if it could not de-list them. If a court determines otherwise, then a litigant may be able to invalidate EPA's determination through the courts more easily than EPA itself could reconsider its own decision. That result is absurd.

[Page 59]

Therefore, before EPA could decline to promulgate the Toxics Rule, *at a minimum* the Agency would need to demonstrate that (1) no carcinogenic HAP is emitted from any EGU in quantities that may cause a lifetime risk of cancer of greater than one in one million in the most exposed individual, and (2) that no HAP is emitted from any EGU at a level exceeding that adequate (a) to protect public health with an ample margin of safety or (b) to assure no adverse environmental effect. *See* 42 U.S.C. § 7412(c)(9)(B). Scientifically, EPA cannot do this. The Utility Study showed that HAP emissions from several EGUs cause a lifetime cancer risk greater than one in one million.[169] Further, EPA's recent case studies on data collected for the Toxics

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[169] 76 Fed. Reg. at 24,998; Utility Study at ES-14.

Rule reflect that at least four EGUs present a lifetime cancer risk in excess of one in one million.[170] Accordingly, even without considering the adverse environmental effects and non-cancer health risks from EGU HAP emissions, EPA must promulgate the Toxics Rule.

5.3 It Is Both Appropriate And Necessary Within The Meaning Of Section 112(n) To Regulate HAP Emissions From EGUs.

Even assuming that one could freely challenge EPA's decision to regulate EGUs under section 112, EPA's decisions that such regulation is and was "appropriate" and "necessary" within the meaning of section 112(n)(1)(A) are well founded. EPA's determinations are grounded on a reasonable interpretation of the directive of section 112(n)(1) to regulate EGUs if "appropriate" and "necessary," and are entitled to substantial deference under *Chevron, U.S.A., Inc. v. Natural Resources Defense Council, Inc.*, 467 U.S. 837, 844 (1984).

Exelon agrees that the scientific and technical evidence in 2000 and today each compel the conclusion that regulation of EGUs under section 112 is both "appropriate" and "necessary." While EPA must "consider" the results of the Utility Study, it would be inappropriate for EPA to read the term "consider" as limiting the Agency to considering *only*

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[170] 76 Fed. Reg. at 24,998; Madeleine Strum, James Thurman, & Mark Morris, EPA, "Non- Hg Case Study Chronic Inhalation Risk Assessment for the Utility MACT 'Appropriate and Necessary' Analysis," at 14-15 (March 16, 2011), EPA-HQ-OAR-2009-0234-2939.

the Utility Study.[171] Indeed, Congress in 1999 directed EPA to consider additional information

[Page 60]
before making its "appropriate and necessary" determination, requiring the Agency to contract with the National Academy of Sciences ("NAS") to evaluate the appropriate level for a mercury exposure reference dose and to consider the results of that analysis in making the Finding. *See* H.R. Rep. No. 105-769, at 281-282 (1998) (Conf. Rep.). EPA cannot ignore either this Congressionally mandated study or other relevant information when it re-evaluates the validity of a rulemaking.

EPA properly considered both health *and* environmental effects in determining that it is appropriate to regulate EGUs. Indeed, a primary health hazard associated with mercury emissions from EGUs is the risk associated with consumption of mercury-contaminated fish, which leads to exposure to methylmercury and increased risk of neurotoxic effects to the developing nervous system

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[171] Even when a statutory requirement provides that a rule must be "based on" a study, which arguably is more limiting language than "consider," that language does not mean that the rule must be based "exclusively" on that study. *Sierra Club v. EPA*, 325 F.3d 374, 377 (D.C. Cir. 2003). *See also Envtl. Defense Fund v. EPA*, 82 F.3d 451, 457 (D.C. Cir. 1996) (per curiam) (describing the phrase "consistent with" as requiring the court to defer to reasonable agency determinations), *amended by* 92 F.3d 1209 (D.C. Cir. 1996); *United States v. United Technologies Corp.*, 985 F.2d 1148, 1158 (2d Cir. 1993) (interpreting statute barring a court's jurisdiction over certain actions "based upon" certain publicly disclosed information to also bar such actions not based solely upon the publicly disclosed information).

and to brain development.[172] That health hazard derives directly from an environmental impact: the deposition of mercury emissions from EGUs into the environment where it is converted to methylmercury and bioaccumulates in fish through the food chain.[173] Humans who consume fish with elevated mercury levels are exposed to the risks attendant to such elevated concentrations. Any interpretation excluding consideration of environmental effects would be absurd.[174]

EPA's interpretation of "hazards to public health" and "environmental effects" as used in section 112(n)(1) is a reasonable construction of the statute. With respect to "hazards to public health," it is reasonable for EPA to look to the de-listing criteria in section 112(c)(9) as a basis for evaluating the

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[172] *See, e.g.*, Technical Support Document: "National-Scale Mercury Risk Assessment Supporting the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units," EPA-452/D-11-002, at 17-19 (March 2011), EPA-HQ-OAR-2009- 0234-3057; Mercury Study, Vol. 1 at 3-22 to 3-25.

[173] *See* Technical Support Document: "National-Scale Mercury Risk Assessment Supporting the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units," EPA-452/D-11-002, at 13 (March 2011), EPA-HQ-OAR-2009-0234-3057; Mercury Study, Vol. 1 at 3-8 to 3-22.

[174] Concern for environmental effects from HAPs imbues section 112. Environmental effects are relevant to whether a pollutant is listed as a HAP, 42 U.S.C. § 7412(b)(2), to whether an area source category is listed for regulation, *id.* § 7412(c)(3), and to establishing residual risk-based standards under section 112(f), *id.* § 7412(f)(2). In section 112(n)(1), Congress specifically directs EPA in the Mercury Study to evaluate environmental effects of mercury emissions from EGUs. 42 U.S.C. § 7412(n)(1)(B).

hazard that warrants regulating HAP emissions from EGUs. That section sets out when Congress deemed it justifiable for EPA no longer to regulate HAP emissions from sources within a source category under section 112. Thus, any health hazard greater than the criteria set out in the de-listing criteria is an appropriate basis for determining that the hazard to public health from EGU emissions warrants regulating that source category under section 112. With respect to evaluating whether HAP emissions from EGUs have environmental effects, EPA appropriately measures the impact in light of the statutory definition of "adverse environmental

[Page 61]
effect" in section 112(a)(7). That definition reflects clear Congressional intent to allow the Agency to consider a wide range of effects, noting that it includes "any" enumerated effect "which may reasonably be anticipated." Congress reinforced this intent in requiring EPA to consider additional standards within eight years of promulgation of standards under section 112(d), both to assure "an ample margin of safety to protect public health" and to prevent an "adverse environmental effect." *See* 42 U.S.C. § 7412(f)(2)(A).

EPA properly applied these standards in reconsidering its 2000 Finding both on the basis of information available in 2000 and available today, and correctly determined that regulation is both appropriate and necessary. The scientific literature and evidence support the conclusion that regulation is both appropriate and necessary. The mass of HAPs emitted by EGUs in 2005, after full implementation

of the controls anticipated by Congress in the 1990 Clean Air Act Amendments, alone makes regulation under section 112 "appropriate" and "necessary." In 2005, EGUs were responsible for more than 50% of the United States' anthropogenic mercury emissions (53 tons), 82% of hydrochloric acid (HCl) emissions (350,000 tons), 62% of hydrofluoric acid (HF) emissions (47,000 tons), 62% of arsenic emissions (200 tons), and 83% of selenium emissions (580 tons).[175] Failure to regulate any source category which was responsible for so significant a share of emissions of toxic pollutants would be arbitrary and capricious.

(a) *EPA's Finding in December 2000 that regulation of coal-fired and oilfired EGUs under section 112 was appropriate and necessary was reasonable in 2000.*

The 2000 Finding was well supported by the Utility Study's conclusions that (1) there was a link between anthropogenic mercury emissions and methylmercury found in freshwater fish (relying upon data from the Mercury Study),[176] (2) mercury emissions from coalfired utilities were expected to worsen by 2010,[177] and (3) methylmercury in fish presents a threat to public health from fish

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[175] *See* Madeleine Strum & Marc Houyoux, EPA, "Emissions Overview: Hazardous Air Pollutants in Support of the Proposed Toxics Rule," at tbls. 1, 3, & 4 (March 15, 2011), EPA-HQ-OAR-2009-0234-2916.

[176] Utility Study at 7-1 to 7-5, 7-14 to 7-15.

[177] *Id.* at 3-15.

consumption.[178] This evidence on mercury alone supports a determination that it is appropriate and necessary to regulate EGUs under section 112 to protect human health.

The evidence in 2000 also established that mercury in the environment presents a threat to human health. It was well known at that time that mercury is "highly toxic, persistent, and bioaccumulates in food chains." 65 Fed. Reg. at 79,827. NAS confirmed EPA's assessment about the toxicity of methylmercury, the form of mercury that deposits in the environment and

[Page 62]
bioaccumulates in fish, and the level of the reference dose ("RfD"). *Id.* EPA reasonably estimated that 7% of women of childbearing age were exposed to methylmercury at levels exceeding the RfD, and that about 1% of women of childbearing age had exposures 3 to 4 times the RfD. *Id.*[179] Most of that mercury is the result of air emissions. When EPA made the Finding, EGUs were the single largest source of mercury emissions in the United States. *Id.* EPA modeling estimated that U.S. anthropogenic air emission sources contributed 60% of the mercury deposited into water bodies and watersheds in the United States. As a result, EPA reasonably estimated that 18% of all mercury deposited in the United States resulted from emissions from EGUs.[180] EPA also collected additional mercury data

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[178] *Id.* at 7-15 to 7-18.

[179] *See also* Mercury Study, Vol. IV at ES-3.

[180] *See* Utility Study at 7-28.

from coal-fired EGUs, which corroborated the mercury emissions estimates in the Utility Study. 65 Fed. Reg. at 79,828. EPA further had recognized that incremental reductions in mercury emissions would lead to incremental reductions in the concentrations of methylmercury that bioaccumulate in fish tissue.[181] Exelon agrees that this evidence compels the conclusion that it was appropriate and necessary to regulate HAP emissions from coal-fired EGUs, particularly in light of the determination at that time that, without regulation, projected mercury emissions from EGUs in 2010 would have increased from 1990 and 1999 emission levels.[182]

The Utility Study also supports a finding that it is appropriate and necessary to regulate EGUs based upon the non-Hg HAP emissions, including nickel emissions from oil-fired EGUs. Exelon agrees with EPA's conclusion in the Finding that the Agency lacked sufficient evidence to conclude that non-Hg HAPs from EGUs posed no hazard and that, therefore, regulating emissions of those pollutants under section 112 was needed. The Utility Study confirmed that some EGUs had emissions resulting in a cancer risk from inhalation greater than one in one million,[183] precluding any decision to de-list EGUs from section 112(c). Therefore, EPA had a reasonable basis for concluding that there was sufficient concern for the risks to public health from non-Hg HAP emissions to deem regulating EGUs appropriate and necessary.

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[181] *See* 65 Fed. Reg. at 79,830; Mercury Study, Vol. I at 3-4.

[182] Utility Study at 3-15.

[183] *Id.* at ES-14.

The fact that control technology existed in 2000 to limit HAP emissions made it eminently reasonable and appropriate to regulate those emissions from EGUs. Section 112 was designed to require existing sources of HAP emissions to reduce their emissions to levels comparable to the best performing sources within the same source category or subcategory. It is particularly appropriate to regulate HAP emissions to support industry's investment into clean

[Page 63]
energy technologies, such as those announced by Exelon in furtherance of its Exelon 2020 Plan. [184]

(b) *EPA's decision to re-affirm its 2000 Finding, although unnecessary, was well supported.*

EPA had ample support for the Finding and had no obligation to review, reaffirm, or buttress it. Nevertheless, Exelon agrees that regulating EGUs under section 112 on the basis of today's facts remains appropriate and necessary. EGUs remain the largest single source of anthropogenic mercury emissions in the United States. [185] Although EPA's present estimate of EGU mercury emissions in 2010 is lower than its projection in the Utility Study of

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[184] EPA correctly recognizes that its attempted rescission of the Finding in 2005 was based upon an illegal and unjustified interpretation of section 112(n), and therefore does not legitimately undercut the basis for the Finding in 2000 or re-affirmation of that Finding now.

[185] 76 Fed. Reg. at 25,002; Technical Support Document: "National-Scale Mercury Risk Assessment Supporting the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units," EPA-452/D-11-002, at 30 (March 2011), EPA-HQ-OAR- 2009-0234-3057.

those emissions, EGUs still contribute nearly half of all mercury emissions in the United States.[186] Absent the Toxics Rule, mercury emissions from EGUs are not expected to decrease any further by 2016.[187] EPA's risk analysis confirms that the risk from mercury emitted from EGUs at 2010 levels that deposits in watersheds, bioaccumulates in fish tissue, and is consumed by humans, threatens public health. 76 Fed. Reg. at 25,007-25,016.[188] Other studies conducted since the Finding confirm that there are serious health risks to the developing fetus from methylmercury exposure and that more methylmercury is distributed to the fetus than was previously estimated, increasing the prospect for neurological deficiencies in newborns.[189] This risk to human health

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[186] 76 Fed. Reg. at 25,002; Madeleine Strum & Marc Houyoux, EPA, "Emissions Overview: Hazardous Air Pollutants in Support of the Proposed Toxics Rule," at 2 to 4 (March 15, 2011), EPA-HQ-OAR-2009-0234-2916.

[187] *See* Madeleine Strum & Marc Houyoux, EPA, "Emissions Overview: Hazardous Air Pollutants in Support of the Proposed Toxics Rule," at 9 (March 15, 2011), EPA-HQOAR- 2009-0234-2916 (comparing final 2016 base case projections with final 2016 policy case projections).

[188] The mercury risk assessment is just one document supporting EPA's decision, on reconsideration, that it remains appropriate and necessary to regulate utility HAPs.

[189] *See* NESCAUM Comments on Finding Revision at 1; Environmental Health & Engineering, Inc., "Emissions of Hazardous Air Pollutants from Coal-Fired Power Plants," at 17-18 (prepared for American Lung Association) (March 7, 2011) ("EH&E Report", attached hereto as Exhibit 23).

[Page 64]
alone justifies regulating EGUs under section 112. Environmental effects from mercury emissions, the creation of "hot spots" from the deposition of mercury in concentrated areas around individual EGUs, and the potential for re-emission of mercury all bolster the basis for regulating HAP emissions from EGUs under section 112.[190]

Exelon also agrees that non-Hg HAP emissions from poorly controlled EGUs present a risk to human health and the environment warranting regulation under section 112. EGUs are the predominant sources of HCl and HF emissions in the United States, as well as the leading or a major source of other non-Hg HAPs, including arsenic, antimony, chromium, nickel, and selenium.[191] These HAPs adversely affect human health. Emissions of HF, HCl, and toxic metals such as antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, nickel, and selenium, which are contained in $PM_{2.5}$, cause severe respiratory problems, cancer, neurological and organ damage, and adverse reproductive effects.[192] HCl exposure

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[190] *See* EH&E Report at 16 (discussing a study showing that coal combustion accounted for 70% of mercury in rainfall in Steubenville, Ohio, and another study in eastern Ohio finding that 42% of the mercury in rain samples was attributable to a nearby coal-fired power plant).

[191] Madeleine Strum & Marc Houyoux, EPA, "Emissions Overview: Hazardous Air Pollutants in Support of the Proposed Toxics Rule," at 4 to 6 (March 15, 2011), EPAHQ- OAR-2009-0234-2916.

[192] *See, e.g., Sierra Club v. EPA*, 479 F.3d 875, 879 (D.C. Cir. 2007) (citing "National Emission Standards for Hazardous Air

has been shown to irritate and restrict the airways of asthmatics, and both HCl and HF irritate and damage eye tissue, nasal passages, and lungs.[193] Fine PM, which includes most non-Hg metals emitted by coal-fired EGUs, are smaller than the width of a human hair and, when inhaled, may deposit along the respiratory tract or penetrate deeply into the lungs from where they can enter the bloodstream.[194] As a result, inhalation of fine PM is recognized to cause cardiovascular effects,

[Page 65]
including heart attacks, and can cause inflammation of lung tissue.[195] More generally, studies

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Pollutants for Brick and Structural Clay Products Manufacturing and Clay Ceramics Manufacturing," 68 Fed. Reg. 26,690, 26,692-94 (May 16, 2003) (to be codified at 40 C.F.R. pt. 63)).

[193] *See* EH&E Report at 13; American Lung Association, "Toxic Air: The Case for Cleaning Up Coal-Fired Power Plants" at 2 (March 2011) ("ALA Report", attached hereto as Exhibit 24).

[194] *See* "National Ambient Air Quality Standards for Particulate Matter: Final Rule," 62 Fed. Reg. 38,652, 38,661-68 (July 18, 1997) (noting that "PM components, especially $PM_{2.5}$, penetrate far more effectively to the airways and gas exchange regions of the lung than does SO_2" and that "while both fine and coarse particles can produce health effects, the fine fraction appears to contain more of the reactive substances potentially linked to the kinds of effects observed [in epidemiological studies]"); Alan H. Lockwood, Kristen Welker-Hood, Molly Rauch, & Barbara Gottlieb, Physicians for Social Responsibility, "Coal's Assault on Human Health," at 21-22 (November 2009), *available at* http://www.psr.org/assets/pdfs/psr-coal-fullreport.pdf; EH&E Report at 19-20; ALA Report at 4.

[195] *See* EH&E Report at 20; Clean Air Task Force, "The Toll From Coal: An Updated Assessment of Death and Disease from

demonstrate that people living in cities with higher fine particle pollution levels have lower life expectancies than people living in cities with cleaner air.[196] Studies of individuals exposed to fine PM reflect that exposure to $PM_{2.5}$ correlates with markers of cardiovascular damage, including irregular heartbeat and pulmonary and systemic inflammation.[197] Thus, EPA has ample evidence to support a determination that non-Hg HAP emissions present a risk to human health.

EPA's risk analyses confirm that regulation of EGUs under section 112 is appropriate and necessary to address non-Hg HAP emissions today. Because the cancer risk estimates indicate that at least one coal-fired and at least one oil-fired EGU emits HAP in quantities which may cause a lifetime cancer risk of greater than one in one million to the individual most exposed to the emissions, the EGU source category would not be eligible for delisting, and regulation under section 112 is legally mandated[198]

It is particularly appropriate to regulate EGUs under the facts in existence today because emissions

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America's Dirtiest Energy Source," Executive Summary at 8 (September 2010), *available at* http://www.catf.us/resources/publications/files/The_Toll_from_Coal.pdf.

[196] *See* EH&E Report at 20.

[197] *See* EH&E Report at 20; "Coal's Assault on Human Health" at 25.

[198] Madeleine Strum, James Thurman, & Mark Morris, EPA, "Non-Hg Case Study Chronic Inhalation Risk Assessment for the Utility MACT Appropriate and Necessary Analysis," at 14-15 (March 16, 2011), EPA-HQ-OAR-2009-0234-2939.

control technology has been further developed. Use of trona and dry sorbent injection has provided proven and cost effective control of acid gases. The stabilization of natural gas prices over the last decade due to the development of abundant shale gas supplies has made fuel switching and switching dispatch to underutilized combined cycle plants more feasible. Moreover, the imposition of toxics controls by increasing numbers of states makes a uniform federal requirement that levels the playing field even more of an imperative today than in 2000.

[Page 66]

(c) *EPA has properly determined the scope of issues to be considered in determining that regulation under section 112 is appropriate and necessary.*

Opponents of regulation take both an untenably narrow and untenably broad view of what EPA can and must consider in determining whether regulating EGUs is appropriate and necessary. They contend, on the one hand, that EPA must consider HAP emissions from EGUs out of the context of the real world and pretend that other emissions do not exist. They contend, on the other hand, that EPA should consider the impact of regulations which may or may not be adopted under the Clean Air Act in the future. They further suggest that the fact that regulation of EGUs under section 112 will not eliminate all risks of airborne HAP contamination somehow makes regulation to reduce those risks inappropriate or unnecessary. Finally, contrary to the structure of section 112 regarding decisions to list, they contend that EPA should consider potential

costs of potential regulations in deciding whether or not to list. None of these contentions has merit.

Any suggestion that EPA should have restricted its consideration solely to the impact of emissions from EGUs without considering the cumulative impacts of these emissions and emissions from other sources is unfounded. Nothing in section 112(n)(1) specifically constrains EPA to assessing whether *only* the emissions from EGUs *independently* present a risk to human health and the environment. Neither does section 112(n)(1) evince any intent to restrict the Agency from considering whether HAP emissions from EGUs, when combined with other HAP emissions, present a risk to public health and the environment.

EPA is equally well founded to interpret section 112(n)(1) to require the Agency to find it appropriate and necessary to regulate EGUs under section 112 if their HAP emissions pose a hazard to public health or the environment at the time of the Finding, rather than only after consideration of the other requirements of the Clean Air Act. The language of the first sentence of section 112(n)(1)(A) describes the scope of the Utility Study, in which EPA is to report on the hazard anticipated to occur ". after imposition of the requirements of this chapter." The requirement later in that subparagraph that EPA consider the Utility Study in making its appropriate and necessary determination does not absolutely restrict the Agency to deciding it *appropriate* to regulate EGUs only after considering all other aspects of the Clean Air Act. Moreover, EPA in fact has considered the other requirements of the Clean

Air Act in deciding whether it is *necessary* to regulate EGUs. Thus, even if EPA is in fact required to consider the impact from other requirements of the Clean Air Act in assessing the public health or environmental risk from HAP emissions from EGUs, it sufficiently has done so.

EPA has also reasonably interpreted "necessary" in light of the phrase "after imposition of the requirements of [the Clean Air Act]" in the first sentence of section 112(n)(1)(A). When Congress in 1990 added to section 112 the directive that EPA perform the Utility Study, it did so at the same time that it amended the Clean Air Act to include the Acid Rain Program ("ARP") designed specifically to address SO_2 and NO_x emissions from EGUs. *See* 42 U.S.C. § 7651(a)(2), (7). In crafting the ARP, Congress recognized that these emissions were controlled by technologies that were available and economically feasible, many of which had co-benefits of controlling for various HAP emissions. Thus, it is reasonable to interpret section 112(n)(1)(A) as Congress's attempt to force the Agency to study whether *additional*

[Page 67]

section 112 standards were necessary to address EGU emissions, after accounting for the reductions that would accompany imposition of the ARP.

It is clear that section 112(n)(1)(A) does not require the Agency to account for other requirements of the Clean Air Act that *may* affect EGUs but do not currently target EGU emissions. For example, future modifications to NAAQS could, if promulgated, eventually lead to reductions in mercury emissions,

but at the time of the Utility Study, the Agency could not adequately assess those potential reductions. The percentage removal of mercury achieved by add-on controls designed to control PM and SO_2 emissions, for example, varied widely and could not be determined with a reasonable degree of confidence at the time the Utility Study was completed.[199] Moreover, with states responsible for implementing the NAAQS, different states are likely to employ different mechanisms for achieving any necessary reductions in criteria pollutants, making it unreasonable for the Agency to assess with confidence the impact to HAP emissions from EGUs from enforcing those standards. In light of the deadline Congress set for EPA to complete the Utility Study – just three years, by November 1993 – it would be unreasonable to read section 112(n)(1)(A) as mandating that EPA predict the impacts many years down the road from certain aspects of the Clean Air Act, such as imposition of new or revised NAAQS standards. Thus, a more reasonable interpretation of section 112(n)(1)(A) is that Congress intended the Agency to determine whether it is necessary to regulate EGUs after accounting for the statutory requirements that unambiguously applied to EGUs at the time the Utility Study was intended.

Nonetheless, EPA went well beyond its obligations under section 112(n) and reasonably determined that, after accounting for *other* aspects of the Clean Air Act, it is still appropriate and necessary to regulate EGUs. Because mercury

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[199] *See* Utility Study at ES-19, ES-25.

emissions from EGUs in 2016 will remain the same as those today *after* taking into account the CSAPR, section 112(g) of the Clean Air Act, the ARP, Federal, state, and citizen enforcement actions related to criteria pollutant emissions from EGUs, and some state rules related to criteria pollutant emissions, the health hazard from those mercury emissions will remain, making regulation under section 112 necessary. 76 Fed. Reg. at 25,017.

Any argument that it is not "necessary" to regulate under section 112 because that regulation will not eliminate all of the hazards from the presence of utility HAPs in the ambient air is internally inconsistent and defies common sense. EPA properly recognizes that it is still "necessary" to regulate HAP emissions from EGUs under section 112 even if doing so will not be sufficient to eliminate entirely the risk to public health or the environment from those constituents. There is no basis for concluding that regulation can be *necessary* only if it can entirely eliminate a hazard, rather than if it would *reduce* the risk or *blunt* the impact of a hazard. *See Massachusetts v. EPA*, 549 U.S. 497, 525-526 (2007).

EPA rightfully excluded costs in assessing whether hazards to public health or the environment are reasonably anticipated to occur from HAP emissions from EGUs. Section 112 does not permit EPA to consider costs in deciding whether to list source categories for regulation

[Page 68]
under section 112(c), in deciding whether to de-list source categories under section 112(c)(9), or in

setting MACT emission floors under section 112(d)(3) for sources in listed source categories. The threshold finding called for by section 112(n)(1) is a finding whether to regulate EGUs *at all* under section 112. At the listing stage, any consideration of costs would be wholly speculative.[200] Even were consideration of cost appropriate or legally permissible now, as Comment 3 and the Cicchetti Report make clear, it would be appropriate to regulate EGUs under section 112 because the Toxics Rule will produce annual benefits at least 7 to 17 times as great as any costs, and probably more.

5.4 Section 112 Requires EPA To Regulate All HAPs Emitted From Coal-Fired And Oil-Fired EGUs.

Section 112 mandates that once EPA makes the determination that it is appropriate and necessary to regulate HAP emissions from EGUs, all HAPs emitted by EGUs must be regulated under section 112. EPA need not make a separate determination under section 112(n)(1) for each and every HAP emitted by EGUs, before it may regulate those emissions in accordance with the terms of section 112. The statute provides unambiguously that EPA must promulgate emission standards for each of the hazardous air pollutants listed for regulation. *Nat'l Lime Ass'n*, 233 F.3d at 633-34. Neither statutory text, legislative history, nor case law supports a position that section 112(n)(1) somehow exempts

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[200] *Cf. Lead Industries Ass'n, Inc. v. EPA*, 647 F.2d 1130 (D.C. Cir. 1980) (holding that EPA properly excluded consideration of costs in establishing NAAQS for lead under section 109 of the Clean Air Act).

EGUs from this requirement applicable to other source categories listed for regulation under section 112(c). Section 112(n)(1) simply requires various studies of HAP emissions from utility units, and includes the requirement that EPA "shall regulate electric utility steam generating units *under this section*, if the Administrator finds such regulation is appropriate and necessary after considering the results of the study required by this subparagraph." 42 U.S.C. § 7412(n)(1)(A) (emphasis added). In requiring that EGUs be regulated "under this section," Congress expressed its clear intention that EGUs be regulated *under section 112*, not under subparagraph (A) of section 112(n)(1).

5.5 EPA Should Not Exclude Any Of The HAPs Regulated Under The Toxics Rule From MACT Standards Using Section 112(d)(4).

Section 112(d)(4) provides the Administrator with discretion to establish healthbased limitations for those HAPs for which a health threshold has been established, provided the health-based standards assure an "ample margin of safety." 42 U.S.C. § 7412(d)(4). These standards may be more or less stringent than MACT technology-based standards. While section 112(d)(4) offers the Agency discretion in certain circumstances, it neither requires the Administrator to exercise that discretion when the Agency regulates pollutants for which a health threshold has been established nor allows the Administrator to decline to regulate without a finding that there is, in fact, an ample margin of

safety to guard against risk to human health and to assure no adverse environmental impact.

[Page 69]

EPA's evolving practice has been to decline to exercise discretion under section 112(d)(4) without clear, verifiable, and substantial bases for determining that a health-based threshold is sufficient to provide an ample margin of safety. This is for good reason. Without such information, the Administrator lacks a basis for exercising her discretion to set a healthbased standard for any HAP. In the Toxics Rule, EPA has no information available to support health-based regulations for HCl or other acid gases, including HF, SeO_2, and HCN. The Agency has not adopted health-based standards for HF, SeO_2, and HCN in any NESHAP, and there is no evidence upon which the Agency reasonably could base a decision to implement such standards in the Toxics Rule.[201] The only relevant HAP for which the Agency has on occasion exercised its discretion under section 112(d)(4) is HCl. But it would be inappropriate for EPA to exercise that discretion here in light of several relevant factors, including the potential for cumulative and synergistic adverse health effects from concurrent exposure to other HAPs and criteria pollutants with similar biological

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[201] *See* 76 Fed. Reg. at 25,050 n.164 (indicating that EPA has not classified HF, Cl_2, SeO_2, or HCN with respect to carcinogenicity); *see also* "National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters; Proposed Rule," 75 Fed. Reg. 32,006, 32,031 (June 4, 2010) (noting the same).

endpoints and the potential environmental impact from HCl.

There is no information upon which the Agency can reasonably rely to determine that HCl emissions along with other respiratory irritants from both EGUs and non-EGUs do not cause additive or cumulative effects. At a minimum, HCl alone has been shown to cause irritation and restriction of airways in people with asthma.[202] Moreover, acid gases (which have additive effects) have been associated with increased bronchitis and reduced lung function, as well as asthma in children.[203] Thus, HCl emissions themselves raise a concern about health impacts to vulnerable populations, even without evaluating the cumulative or synergistic effects of those emissions when coupled with other HAPs and other non-HAP acid gas emissions. From this starting point, the Agency then rightly assumes that some additional risk arises from the additive and synergistic effects of HCl with other emissions unless evidence clearly demonstrates there is no such risk.[204] Here, EPA lacks clear evidence to support a determination that there is

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[202] EH&E Report at 13.

[203] *See id.*

[204] An ample margin of safety must account for uncertainty and variability to assure no person is vulnerable to adverse effects. *See NRDC v. EPA*, 824 F.2d 1146, 1152-53 (D.C. Cir. 1987); H.R. Rep. No. 101-952, at 339 (1990) (Conf. Rep.) (explaining that ample margin of safety was intended to be interpreted as reflected in *NRDC v. EPA* and in the "National Emission Standards for Hazardous Air Pollutants, Benzene Emissions, Final Rule," 54 Fed. Reg. 38,044 (Sept. 14, 1989)). The starting

[Page 70]
no such additional risk. Therefore, EPA cannot find that setting a health-based standard would assure an ample margin of public safety and rightfully errs on the side of protecting public health by mandating MACT standards for HCl and other HAPs. The Agency's position has the added benefit of being consistent with its approach in the Portland Cement [205] and Industrial, Commercial, and Institutional ("ICI") Boiler [206] NESHAPs.

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point for the analysis is the Reference Concentration ("RfC") for HCl. However, the RfC is merely the starting point; while the RfC accounts for some uncertainty by adjusting the no observable effect level for HCl, it does not alone encompass certain factors that Congress intended to be considered as part of the "ample margin of safety," including synergistic and additive effects with other pollutants and environmental impacts. *See* "National Emission Standards for Hazardous Air Pollutants From the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants; Final Rule," 75 Fed. Reg. 54,970, 54,985-86 (Sept. 9, 2010); The Presidential/Congressional Commission on Risk Assessment and Risk Management, "Risk Assessment and Risk Management in Regulatory Decision-Making," Vol. 2 at 110, n.1 (1997), *available at* www.riskworld.com/Nreports/1997/risk-rpt/volume2/pdf/v2epa.pdf.

[205] In the 2010 Portland Cement NESHAP, EPA did not have data on the cumulative impacts of co-emitted acid gases. 75 Fed. Reg. at 54,986. Additionally, EPA did not have data on other pollutants in the vicinity or the background concentrations of HCl, and therefore could not evaluate the cumulative impacts of HCl and other pollutants from other sources. EPA recognized these considerations to be an important part of the ample margin of safety. In reaching its conclusion, EPA declined to give weight to an industry study that was conducted in support of a health-based standard. Noting deficiencies in the study, EPA stated, "the analysis did not consider the impacts of the co-emitted acid gases [Cl2, HCN,

[Page 71]

EPA is not only within its authority, but is required to consider environmental impacts from HCl emissions when considering whether to exercise discretion under section 112(d)(4). The legislative history of section 112(d)(4) confirms that health-based standards should not substitute for conventional MACT standards if they would "result in adverse environmental effects which would otherwise be reduced or eliminated." S. Rep. No. 101-228, at 171 (1998). Section 112(f) requires EPA to

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and HF], an important consideration in determining an ample margin of safety." *Id.* Furthermore, EPA pointed out that the study included no data on background concentrations of HCl or other pollutants from other sources in the vicinity. Finally, EPA recognized that both the industry study and EPA's own study conducted prior to adopting the former Portland Cement standards had failed to sufficiently account for environmental impacts. "The co-emissions of HF, HCN, and Cl_2 from cement kilns could serve to further aggravate these environmental acidification impacts, but EPA has no data to determine these impacts." *Id.* at 54,987.

[206] In the ICI Boiler NESHAP for major and area sources, EPA declined to adopt a healthbased standard, citing limited data, uncertainty about interactions between the various acid gases, uncertainty about the cumulative impacts from co-located and neighboring sources, lack of information on environmental effects, and the possible co-benefits of a MACT-based limit on other HAP reductions. 75 Fed. Reg. at 32,031-32; "National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters; Final Rule," 76 Fed. Reg. 15,608, 15,643-15,644 (March 21, 2011). As in the proposed Toxics Rule, EPA noted the fact that regulated sources are often located in populated urban areas where many other HAP sources are located. EPA determined that these factors "make it more difficult to establish an ample margin of safety." 75 Fed. Reg. at 32,032.

establish a new, more stringent standard sufficient to protect health and to prevent adverse environmental effects if these remain after application of the initial technology-based limits. Thus, Congress could hardly have wanted to restrict EPA's consideration of environmental impacts in establishing the initial limits. HCl emissions are associated with cloud acidity and produce "strong acid" when combined with water, which can contribute to acid deposition.[207] This additional evidence merely reinforces that health-based standards are not appropriate for any HAPs emitted by EGUs and regulated in the Toxics Rule.

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[Page 88]

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7.5 Control Technology Exists That Will Enable Coal-Fired EGUs To Meet The Proposed Emission Limitations.

The emissions control technologies that sources likely would need to install to meet the emission limits proposed in the Toxics Rule have existed for many years. Mercury emission control technology, namely ACI, has been commercially available and capable of achieving 90% or better mercury emission control for more than a decade.[234] URS has

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[207] EH&E Report at 13-14.

[234] NESCAUM Comments on Finding Revision at 9. In 2004 comments on EPA's proposal regarding control of mercury emissions from EGUs, NESCAUM noted that ACI technology had been applied to municipal waste combustors for more than

confirmed that ACI remains a feasible and appropriate control technology for mercury emissions, regardless of the control technologies that may be presently employed by existing EGUs to control for PM, SO_2, or NO_x. For example, existing coal-fired EGUs often control PM with fabric filters or electrostatic precipitators ("ESPs"), control SO_2 with wet or dry FGD systems, or control NO_x with SCR, but regardless of which mix of control a source may already employ to control criteria pollutants, the source should be able to use ACI with SO_3 control, or one or more other control options, to meet the proposed mercury emissions limitation without impairing the ability to control criteria pollutants.[235] Coal switching can also be used in combination with control technologies to achieve the proposed emission limits.[236] Thus, there is no basis for opponents of the Rule to claim that control technology does not exist to enable existing sources to achieve the mercury emissions limits of the proposed Rule.[237] Moreover,

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five years, had routinely achieved more than 90% mercury emissions reduction, and could be applied to coal-fired EGUs.

[235] URS Technology Assessment at 5-7, tbl. 2-1.

[236] *See id.* at 7, tbl. 2-1, Appendix A-11 to A-12.

[237] The experience in Illinois confirms this is true: In testimony at EPA's public hearing in Chicago on May 24, 2011, Mary Gade, president of Gade Environmental Group LLC and former director of Illinois EPA and former EPA Region 5 administrator, testified that the success of control installation activities in Illinois and other states demonstrates that the Toxics Rule's emission standards are achievable without energy price spikes and shortages. Faith Bugel, a senior attorney with the Environmental Law and Policy Center, testified that sources have been able to comply with Illinois' HAP emission standards. *See* Michael Bologna, BNA, "Speakers at Chicago Field Hearing Endorse Air Toxics Proposal, Citing Mercury

regulatory drivers often encourage further development of cheaper, more efficient control

[Page 89]
technologies, and there is no reason to doubt that the requirement that sources install sufficient controls to reduce mercury emissions will not have the same effect. [238]

URS also has confirmed that a suite of technologies are presently available and capable of achieving the reductions called for by the proposed Rule for non-mercury HAPs, regardless of the control technologies presently employed by existing units. URS evaluated several configurations of emissions controls representing a variety of existing units, and concluded that in all instances, those facilities would have one or more options to select additional controls if the existing controls were not performing sufficiently to achieve the emission limitations proposed in this Rule. [239] In most cases, sources controlling for PM with a fabric filter will not require additional controls to meet the non-mercury metallic HAP emission limitation, while sources with ESPs may need to make some upgrades to their control technology. [240] In all instances, sources can reasonably expect to be able to alter source fuels or to select and install suitable controls that will achieve the emissions limitations EPA has proposed.

Reduction," 42 ER 1157 (May 27, 2011) (attached hereto as Exhibit 26).

[238] *See* NESCAUM Comments on Finding Revision at 9-10.

[239] URS Technology Assessment at 7, tbl. 2-1.

[240] *Id.* at 7, tbl. 2-1, 8.

With respect to acid gas emissions, sources already operating scrubbers will likely be able to meet the proposed acid gas HAP limitations without any technical upgrade or addition. Those sources that lack FGD controls may elect to install those controls, or may be able to switch fuels or install dry sorbent injection controls to achieve the acid gas emissions limitations.[241] In any case, sources will be able to identify and to design a suite of control technologies that will meet their particular needs and still achieve the proposed emissions limitations. Only the outdated, inefficient sources that cannot economically bear the costs of installing pollution controls will be forced to retire, an outcome that is fully consistent with the goals and requirements of section 112.

Some have criticized EPA's analysis that DSI is a viable option to control acid gas emissions, and that as a result EPA has underestimated the number of units that will need to install wet or dry FGD controls to meet the proposed acid gas limits. These criticisms are off the mark. DSI is a mature technology that involves injecting one of a number of chemical reagents, including Trona, sodium bicarbonate, and hydrated lime, at various points along the flue gas path, to react with SO_3, SO_2, and acid gases to capture the reaction products.[242] This particular technology is well suited for units that burn fuels with lower or mid-level sulfur contents, and is among the viable options available for a number of sources to achieve the proposed HCl

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[241] *Id.* at 7, tbl. 2-1.

[242] *See* M.J. Bradley Update at 10-11.

limits.[243] Indeed, 73 percent of the sources with HCl emission data in the ICR database already

[Page 90]
achieve the proposed HCl limit, and a number of them employ DSI controls.[244] Several coalfired EGU plants have successfully installed DSI to control SO_2, including NRG's Dunkirk and Huntley power plants, Duke Energy's Gallagher generating station, and GenOn's Potomac River Generating Station.[245] These sources already have achieved substantial reductions in SO_2 emissions with DSI technology. Because DSI reagents react with and remove HCl before SO_2, sources employing DSI to control SO_2 have controlled for HCl (and other acid gases) using that technology. DSI technology may alone be sufficient or will go a long way toward achieving the limits proposed in the Rule. Thus, DSI represents a real technology control option for many units, and is among the suite of technology options that certain units will be able to employ to meet the proposed HCl limit.

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[Page 92]

7.7 EPA Has Incorporated Sufficient Flexibility In The Rule To Mitigate Impacts To Existing EGUs While Assuring That HAP Emissions Are Adequately Controlled.

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[243] *See id.*

[244] *See id.* at 8-9.

[245] *See id.* at 11.

The Agency has appropriately incorporated numerous pragmatic provisions that provide regulated EGUs with flexibility to reduce emissions and achieve compliance in the most cost-effective and efficient manner possible for the particular EGU, while assuring that significant reductions in emissions and the health benefits attendant to such reductions will be realized. These numerous examples include: (1) the work practice standards for dioxin/furans and non-dioxin/furan organic HAPs, (2) EPA's treatment of variability in setting emission standards, (3) the provisions allowing emissions averaging to demonstrate compliance, (4) the

[Page 93]
availability of surrogates to determine compliance, (5) the choice for existing sources to comply with either input-based or output-based emission limitations, (6) the statutory eligibility for a one-year extension to comply with the Rule in the event that the additional time is necessary for installation of controls, consistent with the statutory requirements of section 112(i)(3), and (7) the provision of an affirmative defense to any malfunction.

EPA also has provided sources with a variety of compliance options, thus enabling sources to tailor their compliance program and strategy in the manner that best fits their particular units. EPA has prescribed a flexible array of compliance options for both initial and continuing compliance demonstrations. The Agency has designed the monitoring requirements to encourage the installation and use of continuous emissions monitoring systems ("CEMS"), which would alleviate

the need for costly, frequent stack testing, and has the benefit of enabling a source to identify readily when its control technology has malfunctioned and to minimize the associated harm. However, EPA has not mandated CEMS, thus giving sources some reasonable opportunity to design different compliance programs that best align with the source's short- and long-term plans.

EPA's decision not to set a more lenient standard that would account for malfunctions is reasonable and aligns with the purpose of section 112. Malfunction is unpredictable, sudden, and not capable of easily being classified into types, frequency, or duration. It does not reflect the normal variability in operating conditions for a source, and EPA is not obligated by section 112 to account for variability caused by malfunction in setting MACT standards. Indeed, malfunction can hardly be considered part of the "best performing" sources; it is failure to perform properly. Because EPA already has accounted for variability in the range of typical operating conditions in its MACT determinations, it should not make any further accommodations for malfunctions. EPA has allowed sources to account for malfunctions by establishing an affirmative defense for failing to meet an emission standard on account of a malfunction, *provided* the malfunction was unforeseeable and outside of the source's control. To go further would be inconsistent with Congressional intent to require that sources achieve the average of the best performing sources, which, by definition, requires adequate maintenance and reasonable precautions.

EPA has proposed reasonable and appropriate emission limitations applicable to periods of startup and shutdown for coal-fired EGUs. EGUs are required by law to achieve "continuous section 112-compliant standards," including emission limitations applicable during periods of startup and shutdown. *See Sierra Club v. EPA*, 551 F.3d 1019, 1027-28 (D.C. Cir. 2008). The Agency's approach in the Toxics Rule is reasonable, offering sources the option of calculating input-based emissions based upon a default diluent value or fuel specific CO_2 concentration, or calculating output-based emissions using an electrical production rate of 5% of rated capacity during periods of startup or shutdown.

By proposing a Rule that incorporates numerous pragmatic and, in fact, unduly generous provisions to build in flexibility for sources, EPA has taken reasonable steps to ensure that the Rule will not impose unnecessarily onerous requirements on the electric utility industry and will be targeted to achieve the emissions reductions called for by section 112 in a manner that enables sources to determine the most cost-effective way in which to meet those reductions.

[Page 94]
Thus, EPA should resist calls to make the Rule less stringent on grounds that the Rule will unnecessarily harm the electric utility industry.

* * *

[Cover Page]

EXHIBIT 2

To Comments Of Exelon Corporation On Docket ID No. EPA-HQ-OAR-2009-0234 and Docket ID No.EPA-HQ-OAR-2011-0044 76 Fed. Reg. 24,976 (May 3, 2011)

M.J. Bradley & Associates LLC & Analysis Group, "Ensuring a Clean, Modern Electric Generating Fleet while Maintaining Electric System Reliability" (August 2010) ("M.J. Bradley Report")

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[Page 3]

Executive Summary

In the 20 years since the Clean Air Act ("CAA") Amendments of 1990, electric power companies throughout the United States have deployed a wide range of pollution-control technologies, new power plants with relatively low emissions, and demand-side measures to reduce air emissions from electricity production. The Environmental Protection Agency ("EPA") has found, however, that despite this significant progress in reducing emissions, in 2008 about 127 million Americans still lived in counties with unhealthy air—many of which are located along

the Ohio River Valley, in the Middle Atlantic, and in the Southeast.[1,2]

To begin to address these issues, on August 2, 2010, EPA published its draft Clean Air Transport Rule (the "Transport Rule"), regulating emissions in 31 Eastern states and the District of Columbia where controlling emissions will produce the greatest public health benefit.[3] EPA plans to implement the Transport Rule on January 1, 2012. Additional rulemakings are also underway to regulate hazardous air pollutants ("HAPs"), with EPA under court order to promulgate its final "Utility MACT"

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[1] U.S. EPA, *Draft FY 2011-2015 EPA Strategic Plan*, at p. 7. Collectively, power plants are responsible for 66 percent of SO_2 emissions, 19 percent of NOx emissions, and 39 percent of CO_2 emissions in the U.S. Also, in 2002, the EPA cataloged emissions in the United States and concluded that fossil-fuel-fired power plants were responsible for the following percentages of nationwide emissions for the following HAPs (all figures are approximate): hydrochloric acid (60%); mercury compounds (45%); arsenic compounds (35%); and nickel compounds (25%). U.S. EPA, *2002 National Emissions Inventory Booklet*.

[2] According to the recent National Academy of Sciences, *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use* (2010), "after ranking all the [power] plants according to their damages, we found that the most damaging 10% of plants produced 43% of aggregate air-pollution damages from all plants, and the least damaging 50% of the plants produce less than 12% of aggregate damages" ...(and) the most damaging 10%...account for approximately one quarter of electricity generated at the 406 plants." (at p. 88).

[3] Office of Air and Radiation, U.S. EPA, *Air Transport Rule Factsheet*, at p. 1.

rule by November 2011. According to EPA, compliance would be required by early 2015.[4]

These new rules regulating air emissions from fossil fuel-fired power plants will require certain uncontrolled plants to install pollution control equipment. Third-party analysts have concluded that some coal plant owners may choose to retire units in lieu of such installations. For example, two recent studies suggested that between now and 2015, the combination of low energy prices and EPA air regulations could result in the retirements of between 25 to 40 gigawatts ("GW")[5,6] of the nation's 1,030 GW of electric generating capacity.[7]

Although some of the nation's less efficient power plants may be retired, many existing coal plants will be retrofit with new pollution controls. Approximately half of the nation's coal-fired generating capacity (150 GW) has already installed SO_2 scrubbers, another 55 GW plan to install scrubbers, and a significant number of coal units have already announced plans to retire,[8] leaving approximately one-fourth of the nation's coal-fired

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[4] U.S. EPA, *Proposed Rule: Federal Implementation Plans To Reduce Interstate Transport of Fine Particulate Matter and Ozone. August 2, 2010.*

[5] PIRA Energy Group ("PIRA"), *EPA's upcoming MACT; Strict Non-Hg Can Have Far-Reaching Market Impacts*, April 8, 2010.

[6] ICF International, *EEI Preliminary Reference Case and Scenario Results*. May 21, 2010.

[7] Energy Information Administration ("EIA"), *Electric Power Monthly*, July 2010. (Based on preliminary 2009 capacity, capacity additions and retirements up through April 2010.)

[8] PIRA, *supra* n.5.

generation to add pollution controls, switch to a cleaner fuel, or retire. Companies may also have the option to purchase allowances or adjust dispatch to comply with certain rules.

[Page 4]
Some in the industry have raised concerns about the combined effects over the next five years of anticipated power plant retirements and outages required to install new pollution control equipment. Clearly, the nation must carefully consider how to maintain electric system reliability, while also improving our nation's health and environmental quality.

In this paper, we highlight the impact of EPA's upcoming air regulations, with a focus on the issue of possible power plant retirements on electric reliability. We conclude that, without threatening electric reliability, the industry is well-positioned to respond to EPA's proposed road map to "help millions of Americans breathe easier, live healthier,"[9] provided that EPA, the industry and other agencies take practical steps to plan for the implementation of these regulations and adopt appropriate regulatory approaches. In particular, we conclude the following:

1. **Even though some units likely will retire in lieu of complying with the new regulations, electric system reliability will not be compromised if the industry and its regulators**

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[9] U.S. EPA, *supra* n.1, at p. 2.

proactively manage the transition to a cleaner, more efficient generation fleet.

- Power system reliability relates not only to generation capacity and availability, but also to consumption levels and patterns, and transmission capacity and use. As such, all these factors must be considered when assessing reliability impacts. Existing power system capacity well in excess of minimum reserve levels, relatively modest projections of load growth over the next several years, a large amount of proposed generating resources, and the availability of load management practices indicate the system can handle the level of projected retirements.

- Each North American Electric Reliability Corporation ("NERC") reliability region has excess capacity, totaling over 100 GW of excess capacity nationwide. Therefore, considering only the projected level of coal unit attrition relative to existing capacity resources, it appears there will be no capacity shortages even if projected retirement scenarios prove accurate.

- Further, economic conditions have reduced the demand for electricity in recent years providing an additional capacity cushion to assist in managing any power plant outages required to install pollution controls.

- The industry has a proven track record of adding new generating capacity and transmission solutions when and where

needed and of coordinating effectively to address reliability concerns. In the three years between 2001 and 2003, the electric industry built over 160 GW of new generation—about four times what analysts project will retire over the next five years.

- Notably, many of the regions of the country with organized wholesale markets, including many parts of the Midwest, Mid-Atlantic, and Northeast, have developed effective tools such as capacity markets and reserve sharing mechanisms enabling electric generators to access other companies' available resources to assure regional reliability.

- Additionally, the industry is deploying enhanced demand response actions, expanded energy efficiency programs, and new "smart grid" advances to manage consumption during the transition to cleaner, more efficient generation.

[Page 5]

2. Industry data counter concerns that it will cost the industry too much to comply with EPA's proposed air regulations, that pollution controls cannot be installed soon enough, or that the EPA regulations will lead to the closure of otherwise economically healthy power plants.

- The proven technologies for controlling air pollution emissions, such as NO_x, SO_2, mercury and acid gases, are commercially available and have already been, or soon will be, installed on

the majority of the nation's coal plants (65 percent with scrubbers; 50 percent with advanced NO_x controls), demonstrating that the costs can be managed.

- The industry has a demonstrated ability to schedule and sequence unit outages in an efficient and reliable manner and is capable of installing additional pollution control systems to comply with the Transport Rule and Utility MACT Rule.

- Many of the coal units that are the most likely candidates to shut down are smaller, 40 to 60 year old units, which are nearing the end of their design life expectancy and are already economically challenged.

- Additionally, the retirement of some existing generating capacity will create room on the transmission grid to accommodate additional power flows, or new generating capacity, without requiring attendant upgrades in transmission, thus mitigating reliability concerns while reducing the cost of transitioning to a cleaner, more efficient generation fleet.

3. EPA, the Federal Energy Regulatory Commission ("FERC"), the Department of Energy ("DOE") and State utility regulators, both together and separately, have an array of tools to moderate impacts on the electric industry.

  - EPA may, and if needed, should exercise its statutory authority under the CAA to grant, on a case-by-case basis, extensions of time to

complete pollution control installations where appropriate.

- To the extent that its legal authority allows, EPA should adopt regulatory approaches that allow for cost-effective compliance, such as the emissions trading mechanism proposed in the Transport Rule.

- In circumstances in which power plant retirements trigger localized reliability concerns, EPA and DOE should follow established precedent, including use of consent decrees, to permit continued operation for reliability purposes only, pending necessary upgrades or generation additions. Additionally, the various federal agencies and offices with responsibility for assuring reliability for the nation's electricity capability should work together to help support the industry and states in complying with EPA's new air regulations.

- Transparent, well-established market rules approved by FERC and overseen by independent market monitors, particularly the forward capacity markets relied on by some Regional Transmission Operators ("RTOs"), as well as state regulatory agency oversight, provide additional safety nets to help ensure adequate capacity.

[Page 6]
o Although EPA is under court order to promulgate its air regulations, the Agency can and should coordinate the implementation of anticipated water regulations under Section 316(b) of the Clean Water Act ("CWA") and new waste regulations to avoid possible reliability concerns.[10]

[Page 7]
I. MANAGING ELECTRIC SYSTEM RELIABILITY WHILE IMPLEMENTING NEEDED ENVIRONMENTAL IMPROVEMENTS WITH SIGNIFICANT PUBLIC HEALTH BENEFITS

A. The Electric System Has Substantial Excess Generating Capacity and Appropriate Processes in Place to Assure Reliable Electricity Supply to Consumers

Currently, there are more than 17,000 electric generation units in the United States with a combined nameplate capacity of over 1,030 GW.[11] In 2009, coal-fired generation produced 45 percent of the nation's electricity, followed by natural gas (23 percent) and nuclear (20 percent), with the remaining amount produced through a combination

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[10] EPA should also consider the possible greenhouse gas emissions implications of its 316(b) regulations. In 2007, the U.S. Supreme Court found the EPA has clear statutory authority to regulate greenhouse gases under the CAA. Transitioning to a cleaner generating fleet will help EPA fulfill this obligation.

[11] EIA, *supra* n.7.

of hydroelectric power, oil, wind and other miscellaneous fuel types.[12]

Power plant owners, transmission system owners, and power system operators plan and operate their systems according to numerous federal, state and local regulations, policies and protocols, applying planning requirements designed to ensure electricity suppliers have adequate resources to meet current and future demand, and operational standards to ensure power is available when consumers turn on the lights.

Power system reliability is tied to many things: generation plant capacity and availability, consumption levels and patterns, and transmission capacity and use. As such, electric system planners must consider all of these relevant system infrastructure and demand factors in assessing whether sufficient capacity will be available to maintain reliability. Existing power system capacity well in excess of minimum reserve levels, relatively modest projections of load growth over the next several years, a large amount of proposed generating resources throughout the country, and the availability of load management practices indicate the electric system should be able to handle the transition to a cleaner, more efficient generation fleet.

Under FERC's oversight, NERC sets standards to ensure the reliability of the nation's electric system.

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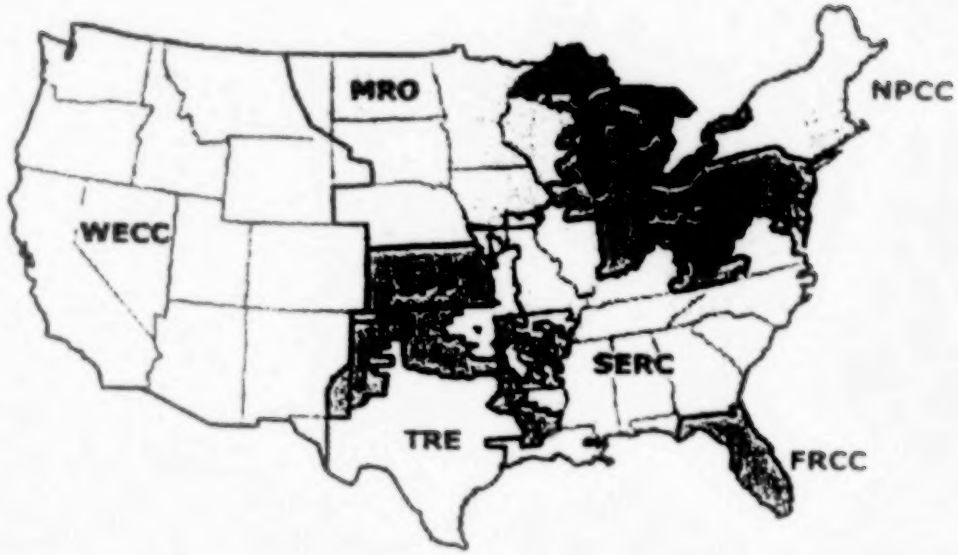
[12] EIA, *Net Generation by Energy Source*, http://www.eia.doe.gov/cneaf/electricity/epm/table1_1.html (accessed July 31, 2010).

NERC comprises eight regional reliability organizations (or "regions," as shown below), whose members include grid operators, utilities, generating companies and others in the electric industry.

[Page 8]

Figure/Table 1 - NERC Electric Reliability Regions



FRCC – Florida Reliability Coordinating Council	**SERC** – Southeast Reliability Corporation
MRO – Midwest Reliability Organization	**SPP** – Southwest Power Pool, RE
NPCC – Northeast Power Coordinating Council	**TRE** – Texas Regional Entity
RFC – Reliability First Corporation	**WECC** – Western Electricity Coordinating Council
Note: NERC regional results shown in this presentation include the continental US only	

[Page 8 cont.]
Most of the nation's regional reliability organizations cover multiple states and each manages and monitors compliance with NERC's reliability standards, including maintenance of minimum target reserve margins, a key indicator of resource adequacy. Actual or expected reserve margins measure the extent to which generating capacity exceeds (or falls short of) peak electricity demand. All regions must have capacity above expected demand to accommodate power plant outages, transmission failures, unexpectedly high demand, or other contingencies. Most regions have a minimum target reserve margin at or below 15 percent.[13] In recent years, actual reserve margins around the country have been well above the minimum target levels, due not only to new power plant additions in most regions, but also to reduced demand attributable to the economic recession and increasingly robust load management programs.[14]

Table 2, below, illustrates that, in 2013, all NERC regions expect to have actual capacity levels well in excess of minimum reserve requirements. Although this provides only one metric of reliability, and each region will undertake more granular analysis in the months ahead, these capacity "cushions" indicate there should not be a capacity shortage even if

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[13] Some regions are below 15%, such as TRE (12.5%), SPP (13.6%), WECC (14.7%). Regions that don't establish a formal target are assigned one for planning purposes by NERC, with 15% for regions like the Midwest and 10% for regions with substantial hydroelectric power. NERC, *2010 Summer Reliability Assessment*, May 2010.

[14] *Id.*

projected retirement scenarios prove accurate. As the table further highlights, on an aggregate basis across all NERC regions, the electric sector is expected to have over 100 GW of surplus generating capacity in 2013, about three times the 30 to 40 GW of retirements projected by PIRA Energy Group.[15,16] Reliability First Corporation ("RFC") and the Southeast Reliability Corporation ("SERC") regions, for example, where most of the uncontrolled coal plants are located, are

[Page 9]
expected to have high reserve margins at 24.3 percent and 26.3 percent, respectively.[17] These regions could retire 17.1 GW (RFC) and 23.9 GW (SERC) of capacity and still maintain the 15 percent NERC reserve margin target.

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[15] NERC, 2009 Long-Term Reliability Assessment: 2009-2018, October 2009.

[16] PIRA, *supra* n.5.

[17] NERC, *supra* n.15.

Table 2 - Estimated Reserve Margins in All NERC Regions: Adequate Generating Capacity

NERC Electric Reliability Region	Projected Reserve Margin[1] in 2013	Cushion Above NERC Target Reserve Margin[2] In 2013
TRE	23.9%	7.8 GW
FRCC	28.6%	6.1 GW
MRO	22.1%	3.2 GW
NPCC	24.4%	5.9 GW
RFC	24.3%	17.1 GW
SERC	26.3%	23.9 GW
SPP	30.3%	7.7 GW
WECC	42.6%	35.6 GW
Total		**107.3 GW**

[1] Includes capacity defined by NERC as Adjusted Potential Reserve Margin, which is the sum of deliverable capacity resources, existing resources, confidence factor adjusted future resources and conceptual resources, and net provisional transactions minus all derates and net internal demand expressed as a percent of net internal demand. Source: NERC, *2009 Long-Term Reliability Assessment: 2009-2018*, October 2009, p. 396 (Summer Demand).

[2] Capacity in excess of what is required to maintain NERC Reference Margin or the regional target reserve levels.

Source: NERC, *2009 Long-Term Reliability Assessment: 2009-2018*, October 2009.

Experience in the RFC region, which encompasses thirteen states in the Midwest and Mid-Atlantic regions, is illustrative of the electric system's ability to tolerate retirements without jeopardizing reliability. Generators in the PJM Interconnection ("PJM") retired about 6,000 MW of capacity between 2004 and 2007, and over 3,000 additional MW of capacity have been announced for retirement in PJM by 2012.[18] Despite almost 10,000 MW of retirements over this seven year period, the RFC region is still forecast to have a reserve margin of over 24 percent in 2013, or an excess of 17,000 MW of generation above the 15 percent NERC target reserve margin target.

Moreover, as a result of the economic recession, NERC projects "significant reductions in projected longterm energy use in North America"[19], which provide an additional capacity cushion. While total demand is still projected to increase in most regions, it will do so at a slower pace and from a lower starting point. See, for example, Figure 2 which shows the decrease in forecast energy use from NERC's 2009 long-term reliability assessment as compared to its 2008 forecast. Additionally, summer peak demand has decreased over 10 GW per year for two consecutive years.[20] Furthermore, in all regions of the country, well-established tools exist to analyze potential regional power system impacts, and to

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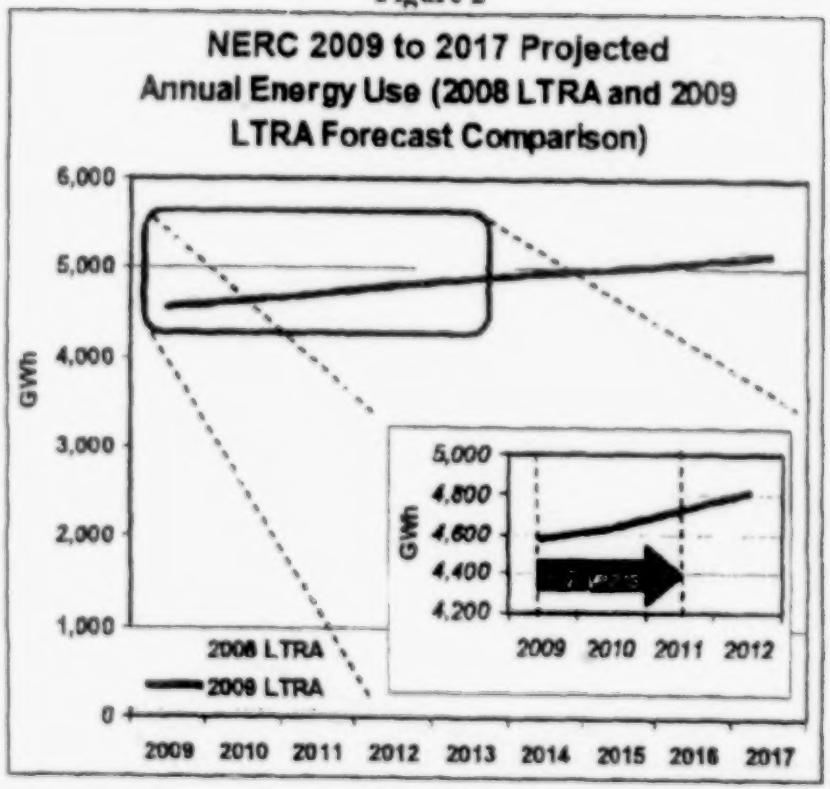
[18] PJM, *Generation Retirement Summaries*, http://www.pjm.com/planning/generation-retirements/gr-summaries.aspx (accessed July 31, 2010).

[19] NERC, *supra* n.15, at p. 13.

[20] NERC, *supra* n.13, at p. 1.

facilitate planning, managing and operating the system to ensure ongoing reliability.

Figure 2



Source: NERC, *2009 Long-Term Reliability Assessment: 2009-2018*, October 2009, p. 13.

B. The Electric Industry Has Proven Its Ability to Avoid Capacity Problems in the Past—Through Power Plant Capacity Additions, Fuel Conversions, Transmission Solutions, and Load Management Techniques

1. New Capacity is Already in the Pipeline

Even with the robust reserve margins in all NERC regions, industry participants are pursuing various measures to safely and reliably transition to cleaner, more efficient electric supply resources. Plans are underway for a variety of new plants, even as less efficient ones are retired. While economics remains the major consideration in deciding whether to develop or expand generating capacity or to mothball older plants, other major drivers, including reliability and environmental improvements, are in play. For example, the implementation of forward capacity markets in certain Independent System Operators (ISOs) has provided more price transparency, enabling the industry to see the value of various generation resources.

Moreover, the industry has shown previously that it can efficiently add capacity or respond adequately to potential reliability issues. Between 1999 and 2008, for example, in response to a variety of market, regulatory and economic signals, the electric sector added almost 270 GW of natural gas-fired generating capacity, the equivalent of more than 80 percent of the entire existing U.S. coal fleet.[21] (See Figure 3 below, which shows the

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[21] EIA, *Annual Electric Generator Report: Form EIA-860*, 2008.

significant investment in new gas plants during the past decade.) Indeed, in just three years between 2001 and 2003, the electric industry built over 160 GW of new generation,[22] about four times what analysts project will retire over the next five years. Although conditions a decade ago

[Page 11] differ in several respects, this robust construction cycle suggests that developers and investors will respond to strong signals if new capacity is needed.

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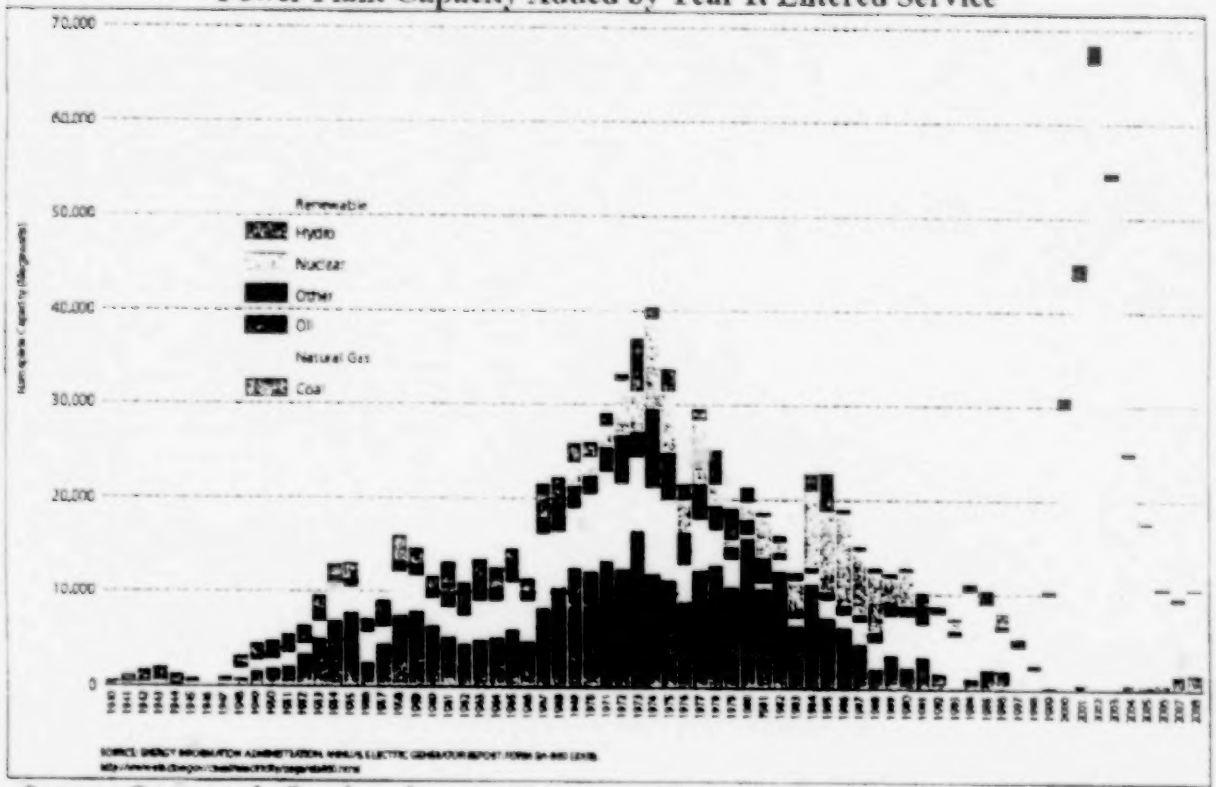
[22] *Id.*

Figure 3
Power Plant Capacity Added by Year It Entered Service



Source: Ceres, et al., *Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States*, June 2010.

There are also examples in which the industry responded quickly and effectively to resolve looming reliability problems. In the mid-1990s, for example, three large nuclear generating units in Connecticut, totaling almost 3,000 MW, were unexpectedly and simultaneously unavailable during lengthy outages[23], transforming Connecticut from a power exporter to a net importer. To avert any reliability problems over the extended outages, the regional grid operator, along with the region's utilities and public officials, instituted a variety of measures including adjusting unit maintenance schedules, executing additional interruptible contracts with large commercial customers, installing new generation and transmission equipment, and coordinating closely with neighboring power systems to maximize out-of-state power purchases.[24] If necessary, the industry could employ similar strategies in response to future coal plant retirements.

Further, as indicated in Table 3 below, substantial new capacity build has been announced, planned or is seeking grid interconnection studies. Across the NERC regions, a recent report identified over 55 GW of proposed generation in advanced stages of development in the queue for 2013. Although, not all of these plants will be built, strong market incentives and signals from regulators that new capacity will be

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[23] Western Massachusetts Electric Company, *Form 8K*, November 25, 1996, "Other Events."

[24] PRNewswire, NEPOOL: *Power Supplies May be Tight in New England This Summer*, June 11, 1996.

needed will promote generation development proposals beyond those announced to date.

[Page 12]

Table 3 - Proposed New Build – 2013[25]

NERC Region	New Generation Proposed to Be Built (in Transmission Queues for 2013)
TRE	4.3 GW
FRCC	2.0 GW
MRO	3.6 GW
NPCC	7.5 GW
RFC	8.7 GW
SERC	10.3 GW
SPP	2.8 GW
WECC	16.3 GW
Total	55.5 GW

Note: There are substantial additional generating facilities in the queue in each region.

Numerous electric companies have already announced substantial new capacity additions, many at the sites of existing coal units that will be retired.

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[25] ICF International, *supra* n.6.

Georgia Power, which recently demolished a coal plant in Georgia and stated its intention to retire another, announced it plans to build three 840 MW combined cycle gas turbines ("CCGTs") in Georgia.[26] Oglethorpe Power Corporation has proposed a 605 MW CCGT[27] and a 100 MW biomass facility in Georgia.[28] Also in the Southeast, Progress Energy plans to build a 950 MW CCGT at the site of three coal units, which will retire when the gas plant comes online.[29] In Tennessee, TVA is building an 878 MW CCGT at the site of its John Sevier coal plant, and the City of Vineland New Jersey plans to replace its 25 MW coal plant with a 60 MW gas plant.[30,31]

Also, although they do not operate in the same base load mode as do nuclear or many coal plants, low emission energy facilities have expanded rapidly over the past several years.[32] For example, the total wind power capacity now operating in the U.S. is over 35,600 MW. In 2009 alone, the U.S. wind

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[26] Georgia Power, *From Coal to Natural Gas*, http://www.georgiapower.com/generation/home.asp (accessed July 31, 2010).

[27] Oglethorpe Power, *Oglethorpe Power to Build Gas-Fired Generating Plant*, March 10, 2010.

[28] Power-Gen Worldwide, *Oglethorpe plans a biomass plant*, June 29, 2010.

[29] Energy Business Review, *Progress Energy Wins Approval To Build 950MW Gas-fired Plant*, October 2, 2009.

[30] Marketwire, *TVA Prepares to Begin Construction on 880-Megawatt Combined-Cycle Unit*, March 16, 2010.

[31] NJ Spotlight, *NJ Coal Plants Face Cleanups and Closures*, July 10, 2010.

[32] Wind and solar are intermittent resources; therefore, only part of their output is credited for reliability purposes.

industry broke all previous records by installing nearly 10,000 MW of new generating capacity, enough to serve over 2.4 million homes. Additionally, over 400 MW of solar was installed throughout the nation in 2009. Solar installations are poised to grow about 50 percent annually in the next three years, reaching 1.5 GW to 2 GW of new installations in 2012.[33]

The retirement of inefficient coal units may spur further development of cleaner generating capacity. Regional transmission studies include capacity even if it runs infrequently. Freeing room for new capacity through retirements means some low emission generation resources, including gas plants, can be accommodated without having to invest in new transmission.

[Page 13]

2. Existing Gas Units Have Untapped Power Production Potential

Given the significant addition of gas-fired capacity in the past decade, as detailed earlier in Figure 3, and the relative price advantage of coal versus natural gas in the period from 2007 to 2008, gas plants were not operated at their full design capability in many parts of the country. As detailed in Table 4 below, gas-fired CCGT power plants in 2008 had an average utilization rate of only 33 percent, as compared to coal's 56 percent. Despite declines in natural gas prices, existing gas units have significant untapped

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[33] GTM Research, *The United States PV Market Through 2013: Project Economics, Policy, Demand and Strategy*, December 2009.

power production potential, which can be expanded during off peak periods without constructing new generation. This excess capacity can assist in managing power plant outages required to install pollution control systems

[Page 13 cont.]

Table 4 – Estimated Utilization of U.S. Coal and Gas Plants (CCGT) by Region (2008)

		Coal		Gas	
Region	Plant Size (MW)	Total Installed Capacity (MW)	% Utilization	Total Installed Capacity (MW)	% Utilization
FRCC	> 500	7,981	67%	17,678	46%
	200 - 500	1,628	64%	2,410	26%
	< 200	199	53%	1,389	20%
MRO	> 500	18,113	73%	3,033	15%
	200 - 500	4,915	59%	1,246	15%
	< 200	3,111	42%	506	10%
NPCC	> 500	2,407	79%	13,791	44%
	200 - 500	2,548	70%	4,326	36%
	< 200	1,079	47%	2,843	21%
RFC	> 500	99,474	61%	28,087	19%
	200 - 500	11,479	54%	2,709	13%
	< 200	4,664	48%	1,794	34%
SERC	> 500	91,188	66%	40,529	24%
	200 - 500	10,699	57%	4,995	29%
	< 200	4,109	36%	1,229	33%
SPP	> 500	17,870	71%	12,051	32%
	200 - 500	2,361	72%	2,116	37%
	< 200	647	44%	465	22%
TRE	> 500	15,193	80%	28,869	44%
	200 - 500	1,213	82%	5,025	36%
	< 200			1,020	24%
WECC	> 500	30,081	73%	37,435	47%
	200 - 500	2,992	78%	6,835	40%
	< 200	2,465	60%	5,042	49%
All US Plants	> 500	282,407	67%	181,473	35%
	200 - 500	38,277	60%	30,136	32%
	< 200	16,616	45%	15,966	30%

Source: MJB&A analysis based on U.S. Energy Information Administration's Form EIA-860 (2008) and EIA-923 (2008)

[Page 13 cont.]
Additionally, many coal plants have the potential to repower their units, by replacing conventional coalfired steam electric generating units with CCGTs, thus increasing the units' efficiency *and* reducing air emissions—an approach already being used today by the industry. For example, Xcel Energy has replaced a 270 MW coal plant in Saint Paul, Minnesota with a 515 MW CCGT, reducing SO_2 emissions by 99.7 percent, NO_x emissions by 96.9 percent, and eliminating mercury emissions.[34] It also repowered

[Page 14]
two coal units in Minneapolis.[35] In New Jersey, Calpine has announced its intent to convert an 83 MW coal unit to a 158 MW gas unit.[36]

3. Enhanced Load Management Programs Can Be Deployed to Meet System Reliability Needs Economically

Historically, grid operators have dispatched plants to meet customers' electricity requirements. Over the years, the industry has recognized that decreasing load requirements can be more efficient and economical than increasing supply by dispatching generation. As a result, load management tools, such as demand response ("DR") and energy efficiency

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[34] Utility Engineering, *Twin Cities to breathe easier thanks to UE, Value Connection*, Issue 2, 2007.

[35] North Dakota Home Town Times, *Xcel Energy Switches Minneapolis Coal Plant to Natural Gas*, October 13, 2009.

[36] NJ Spotlight, *supra* n.31.

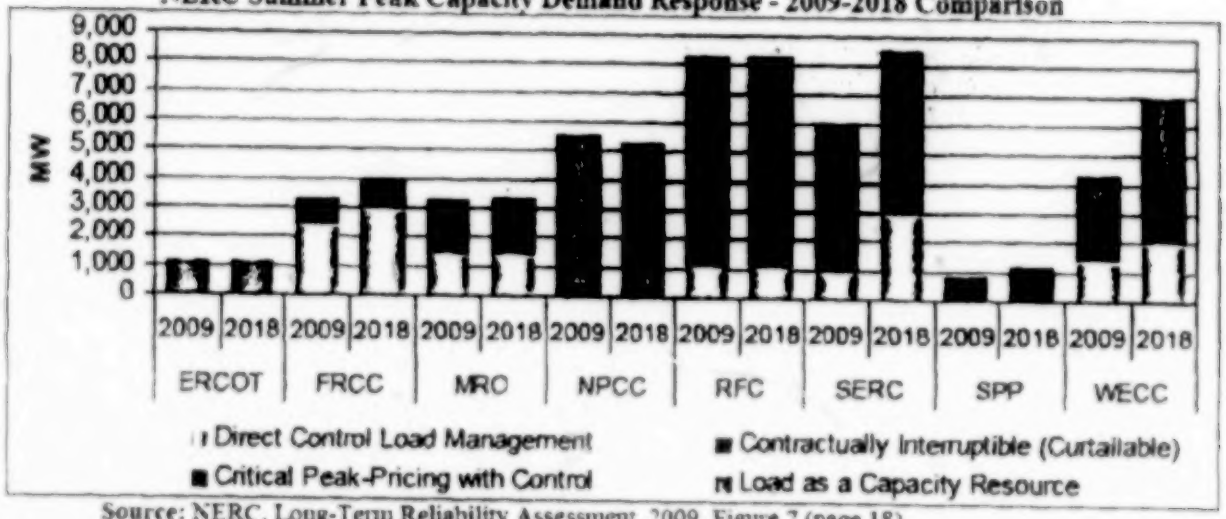
("EE") programs have been widely implemented across the nation.

DR programs manage load by temporarily reducing or shifting electricity use by homes or businesses during critical times like hot summer days. EE programs, on the other hand, primarily seek to reduce consumers' energy use on a permanent basis through the installation of energy efficient technologies and conservation measures. Both means of load management provide an additional tool for system operators to manage electric reliability.

DR programs operate in all of the NERC Regions, as shown in Figure 4 below. In some regions, such as RFC, SERC, WECC, and MRO, a substantial fraction of the DR resources are available in the form of "contractually interruptible" or curtailable loads. These typically entail contracts between a utility and an industrial customer, in which the customer agrees to curtail part of its usage when requested for a specified number of times during a certain period, in exchange for electric rate discounts. The other forms of DR—direct control load management, critical peak pricing with control, and load as a capacity resource—are more dynamic forms of supply, in which the grid operator, in effect, dispatches the load to respond with a reduction or shift in load, much like a generating facility.

[Page 14 cont.]

Figure 4
NERC Summer Peak Capacity Demand Response - 2009-2018 Comparison



Source: NERC. Long-Term Reliability Assessment. 2009. Figure 7 (page 18).

In particular, these other forms of DR have increased steadily in organized wholesale competitive markets. In PJM, for example, DR has increased five-fold in the past five years and continues to grow.[37]

[Page 15]
In the most recent PJM capacity auction, DR offers increased 32 percent over last year and over 9,000 MW cleared, which represents about six percent of total available capacity resources.[38] DR is expected to reduce the peak electricity use this summer in PJM by 8,525 MW, the equivalent output of ten large power plants.[39]

DR is not just increasing in PJM. According to the ISO/RTO Council, competitive markets are "shattering barriers" in terms of attracting DR resources.[40] In FERC's recently released *National Action Plan on Demand Response*, it highlighted that DR has tripled in recent years in the New England region[41] and identified strategies to further enhance DR. Already, about half of electric utilities across the nation have some type of DR program. With continued support from regulatory agencies like

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[37] PJM, *Demand Response To Play Significant Role In Meeting PJM's Higher Summer Peak Electricity Use*, http://pjm.com/~/media/about-pjm/newsroom/2010-releases/20100505-summer-2010-outlook.ashx (accessed August 6, 2010)

[38] PJM, *2013/2014 RPM Base Residual Auction Results*, at p. 1.

[39] PJM, *supra* n.37.

[40] ISO/RTO Council, *2009 State of the Markets Report*, September 22, 2009.

[41] The Federal Energy Regulatory Commission Staff, *National Action Plan on Demand Response*, June 17, 2010, at p. 7.

FERC and the advancement of "smart grid" technologies, DR is expected to continue to grow as a viable supply alternative to traditional generation.

As with DR, EE programs have increased dramatically in the past several years. According to information compiled by the Consortium for Energy Efficiency, and as highlighted in Figure 5, the total budget for all US ratepayer-funded EE and DR programs has increased 80 percent since 2006 to $4.4 billion in 2009.[42] These programs resulted in savings of almost 105,000 gigawatt hours ("GWh") of electricity in 2008—the equivalent of the total electricity consumption in Tennessee in the same year.[43] By 2018, new EE programs alone are expected to reduce summer peak demands by almost 20,000 MW (a full year's growth).[44]

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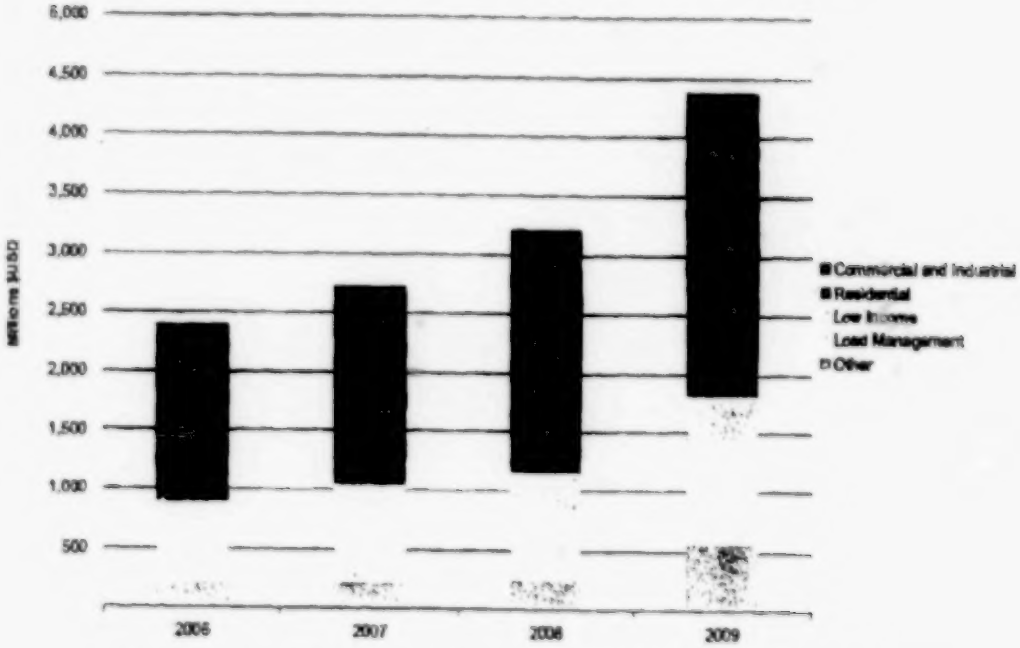
[42] Consortium for Energy Efficiency ("CEE"), *The State of the Efficiency Program Industry: Budgets, Expenditures, and Impacts, 2009*, at p. 7.

[43] *Id.*

[44] NERC, *supra* n.15, at p. 12.

[Page 16]

Figure 5
Energy Efficiency and Demand Response Program Budgets, 2006-2009



Source: Consortium for Energy Efficiency, *The State of the Efficiency Program Industry: Budgets, Expenditures, and Impacts*, 2009

Although California and the Northeast account for over half of the total, budgets for ratepayer-funded EE programs are expanding in all regions of the country. In 2009, EE budgets for Illinois, Wisconsin, and Iowa increased in 2009, year-on-year, by 60 percent, 40 percent, and 36 percent, respectively.[45] In the Southeast, Alabama, Mississippi, North Carolina, and Louisiana reported ratepayer-funded EE budgets for the first time in 2009.[46] EE's use as a capacity resource is increasing in organized wholesale markets as well. For example, EE resources accounted for 757 MW of the resources offered into the most recent PJM RPM auction, an increase of 33 percent over the prior year. Of those resources, 90 percent, or 680 MW cleared the auction to serve as a firm capacity resource.[47] NERC estimates that current levels of EE and DR will shave off certain portions of expected growth in demand, as shown in Figure 6, below, underscoring growing acceptance of these load-management tools.

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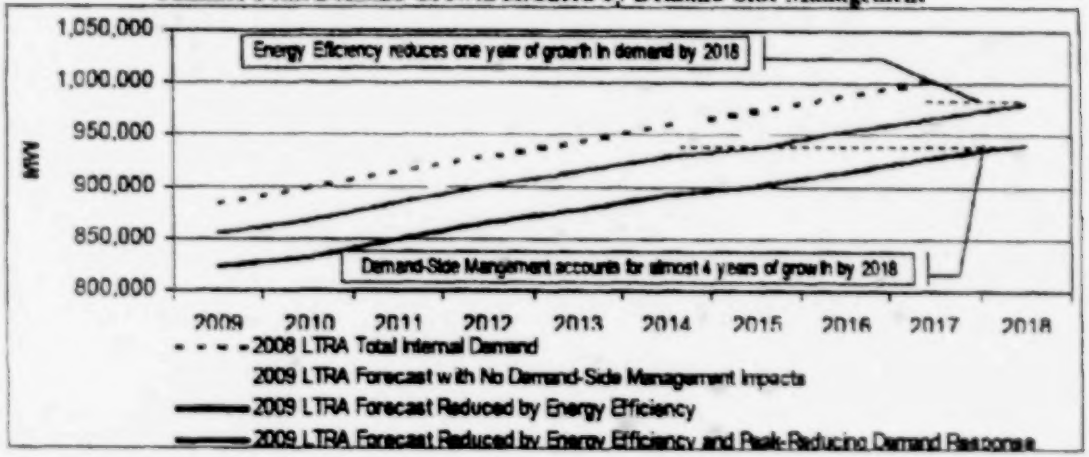
[45] CEE, *supra* n.42, at p. 15.

[46] *Id.* at p. 16.

[47] PJM, *supra* n.38.

[Page 17]

Figure 6
Summer Peak Demand Growth Reduced by Demand-Side Management



Source: NERC. Long-Term Reliability Assessment. 2009. at p. 18.

Based on the experience of states and organized competitive wholesale markets that have implemented EE and DR, it is clear these programs provide yet another cost-effective tool to help maintain reliability in the face of generation retirements.

II. THE INDUSTRY HAS THE CAPACITY TO TIMELY RESPOND TO EPA'S FUTURE AIR REGULATIONS

A. The Majority Of Coal Plants Have Already Installed Air Pollution Controls

Proven pollution control technologies are widely available to dramatically reduce emissions of NO_x, SO_2, mercury, and other HAPs from coal plants, which account for 98 percent of the electric sector's SO_2 emissions, 86 percent of its NO_x emissions, and 98 percent of its mercury emissions.[48, 49]

Over the last 20 years, the industry has deployed a number of different technologies to comply with federal and state SO_2 and NO_x regulations. The three basic options for reducing SO_2 emissions from coal plants include: (1) switching from higher to lower sulfur coal; (2) blending higher sulfur coal with lower sulfur coal; or (3) installing flue gas desulfurization ("FGD") control systems, commonly referred to as scrubbers. Wet scrubbers, which use a sorbent to capture SO_2, can typically achieve at least 95 percent SO_2 removal. Widely available NO_x control technologies for coal generation can be grouped into two broad categories: combustion modifications and post-combustion controls. Post-combustion controls

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[48] EIA, *U.S. Electric Power Industry Estimated Emissions by State (EIA-767 and EIA-906)*, Electric Power Annual 2008, http://www.eia.doe.gov/cneaf/electricity/epa/emission_state.xls (accessed July 30, 2010)

[49] U.S. EPA Office of Air Quality Planning and Standards. *National Emissions Inventory for Hazardous Air Pollutants*, 1999.

can reduce NO_x emissions by 90 percent or more by removing the NO_x after it has been formed in the boiler. The most common post-combustion control is selective catalytic reduction ("SCR") technology, in which ammonia (NH_3) is injected, combining with the NO_x in the flue gas to form nitrogen and water.

The majority of coal plants have already installed such controls. Of the 310 GW of coal capacity in the United States, 150 GW have installed FGD systems and another 55 GW have FGD controls planned,[50] representing 65 percent of the existing coal fleet. As detailed in Attachment A, numerous scrubber installations have been recently completed or soon will be completed. Additionally, about 50 percent of coal capacity in the U.S. has installed or soon will be retrofit with advanced NO_x controls (SCR and selective non-catalytic reduction ("SNCR") technologies).[51]

To date, most studies put a heavy emphasis on deploying scrubbers to comply with the new EPA air regulations. Retirements occur where the costs of installing scrubbers does not make economic sense based upon the unit's characteristics. However, a number of companies have announced that they will use other less costly technologies in lieu of scrubbers. For example, on August 5, 2010, Edison Mission International, one of the nation's largest merchant coal generators, announced it could achieve

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[50] PIRA, *supra* n5, at p. 7.

[51] U.S. EPA, *National Electric Energy Data System ("NEEDS")*, version 3.02.

compliance without installing scrubbers by using trona injection technology.[52]

B. With Proper Planning, the Industry Can Install the Necessary Pollution Controls on a Timely Basis

EPA projects that about 14 GW of additional coal-fired generating capacity will need to be retrofit with scrubbers and less than 1 GW with SCR controls by 2014 to comply with the recently proposed Transport Rule.[53] This number of retrofits is significantly less than the industry has added in past construction

[Page 19]
cycles. For example, during the peak of scrubber construction, between 2008 and 2010, approximately 60 GW of coal capacity was retrofit with scrubber controls,[54] highlighting the industry's ability to complete a substantial number of retrofits over a short period of time. In 2009 and 2010, the industry

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[5] Trona is a naturally occurring sorbent that can be injected directly into boilers to remove harmful air toxics without the use of FGD scrubbers. Given that the PIRA and EEI analyses did not consider trona and other less costly compliance options, the predicted retirement scenarios are very likely overstated. Nonetheless, this report uses the predicted retirements as a conservative input to test all of the reliability considerations.

[53] U.S. EPA, *Proposed Rule: Federal Implementation Plans To Reduce Interstate Transport of Fine Particulate Matter and Ozone,* August 2, 2010.

[54] M. J. Bradley & Associates analysis based on U.S. EPA NEEDS Database v. 3.02.

completed between 50 and 60 scrubber retrofits each year.[55]

Moreover, the industry's past successful installation of pollution controls on numerous units underscores its ability to schedule and sequence any required unit outages in an efficient and reliable manner. To help ensure reliability, generators and transmission owners provide reasonable advance notice of any planned outages to the respective transmission authorities. In turn, the transmission authorities develop a coordinated outage schedule to prevent any deliverability problems. This illustrates a key benefit of a fully integrated national transmission system.

Further, the CAA allows three years for existing sources to comply with the Utility MACT rule with the possibility of a one-year extension. EPA is under a court-imposed deadline to complete its regulations by November 2011, with compliance required by late 2014. As numerous states have adopted regulations limiting mercury emissions from coal-fired power plants, many companies have already begun to install mercury control technologies. Also, the scrubber and particulate control systems installed to comply with the Transport Rule and other EPA regulations will help companies to comply with future air toxics regulations.

In the event, however, that any required retrofit construction schedules could not be completed within the pre-compliance period, EPA may, and should, exercise its authority under Section 112(i)(3)(B) of

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[55] *Id.*

the CAA to provide up to one-year extensions to complete pollution control installations. In addition, to protect the national security interest of maintaining adequate electrical grid reliability, the President has the authority under Section 112(i)(4) of the CAA to grant one or more compliance extensions of up to two years each. Any such extensions would be unit-specific and based on clear demonstration that the technology to implement such standards is not available.

These federal tools combined with market rules and signals, industry reliability standards and enforcement mechanisms, and utility regulatory requirements and incentives, provide a robust portfolio of techniques to assure compliance with health-based air regulations while maintaining reliable electricity supply.

C. The Coal Plants Most Likely To Retire Are Nearing The End Of Their Design Life Expectancies And Are Already Economically Challenged

As indicated by Table 5 below, many of the uncontrolled coal units, which are the most likely to retire, are smaller (250 MW and below) and are 40 to 60 years old. Thus, the coal plants most likely to retire are already nearing the end of their design life expectancies, as confirmed in recent coal plant retirement announcements, detailed in Attachment B.

[Page 20]

Table 5 - Characteristics of U.S. Coal Plants

Unit Age	Units		Capacity		Avg. Unit Size	Pollution Control Installed (% of units)			
	Count	%	MW	%	(MW)	SNCR	SCR	Scrubber	Uncontrolled
> 60 years	46	5%	1,762	1%	38	2%	4%	11%	87%
51 - 60 years	313	31%	39,787	13%	127	21%	9%	19%	64%
41 - 50 years	233	23%	58,078	20%	249	15%	19%	33%	53%
31 - 40 years	229	23%	114,090	38%	498	4%	43%	65%	27%
11 - 30 years	163	16%	80,165	27%	492	6%	29%	68%	31%
10 years or younger	7	1%	2,444	1%	349	43%	29%	57%	29%
Total	1,004		297,639			13%	23%	41%	48%

Data Sources: 2007/2008 EPA IPM, ARP, NBP Databases & Commercial Sources, MJB&A Analysis

[Page 20 cont.]
Information included in the most recent annual *State of the Market Report* prepared by PJM's Independent Market Monitor ("IMM") suggests that fundamental economics, not the EPA regulations, are already challenging those units most likely to retire. In that report, the IMM identified over 11 GW of coal units at risk for retirement, since they "did not recover avoidable costs even with capacity revenues."[56] Of the 11 GW identified in the report, most operated less than 1,000 of the 8,760 hours in 2009 and tended to be significantly smaller with an average installed capacity of only 73 MW.[57] Of the 122 coal units in PJM with capacity less than or equal to 200 MW, 35 failed to recover their avoidable costs and another 52 were close to not recovering those costs. Therefore, in PJM, a region covering 13 states and DC, in addition to approximately 10 GW of coal generation that has or will be retired during the seven years from 2004 to 2011, another 11 GW faces a troubling economic outlook. As such, the units' economics already place them at risk of shutdown, regardless of EPA's future air regulations.

In reducing the air pollution emissions from some of the nation's most inefficient uncontrolled units, EPA will facilitate the development of cleaner, more efficient generation while improving air quality and reducing greenhouse gas emissions. The current levels of air pollution in certain regions of the country require industrial facilities and power plants

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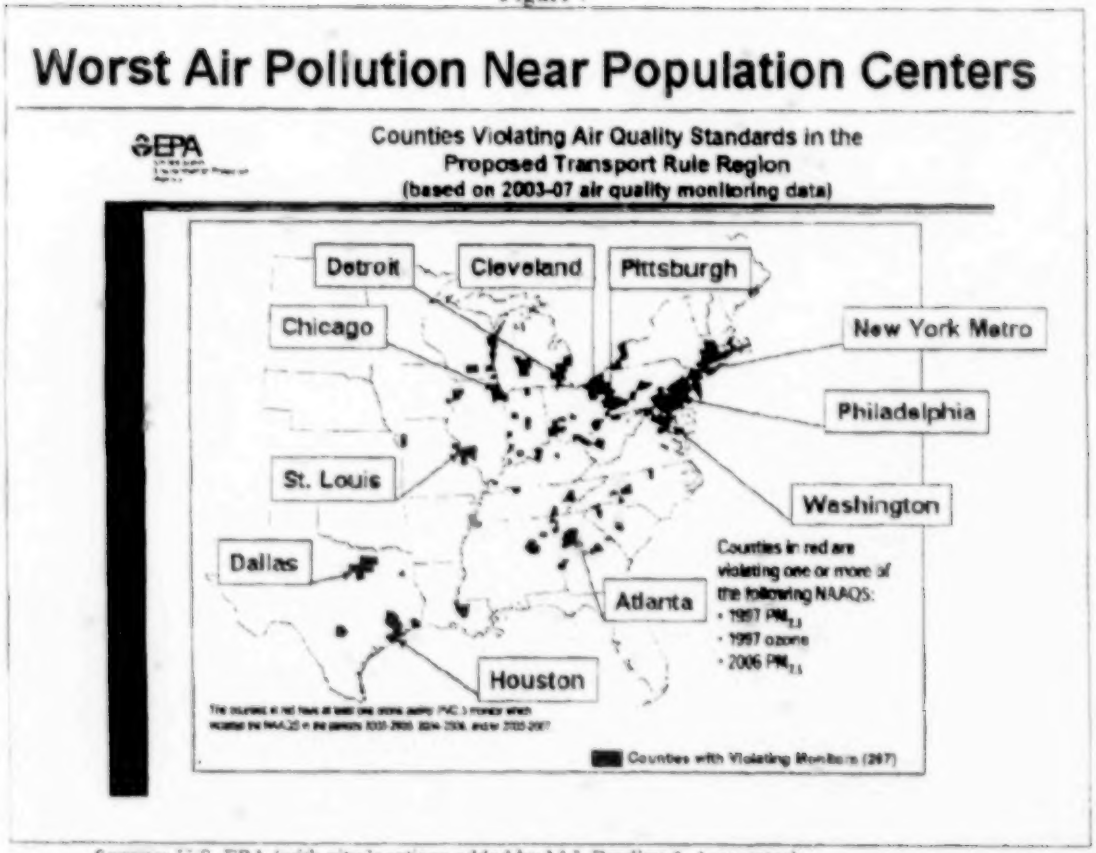
[56] PJM, *State of the Market Report*, Vol. 1, March 11, 2010, p. 21.

[57] *Id.* Vol. 2 at p. 176.

to obtain emission offsets to expand their operations. This requirement discourages economic development due to the increased permitting and financial obligations compared to areas that meet federal and state air quality standards. Significantly as well, as shown in Figure 7, because these non-attainment areas are concentrated in highly populated areas, reducing emissions there will facilitate the development of cleaner, more efficient generation near electric load centers where it is needed most.

Additionally, the retirement of generating capacity that has been previously supported by transmission investment could create room on the transmission grid to handle power flows both within and outside the regions, or the addition of new generating capacity, without requiring attendant transmission upgrades. These considerations, too, will help mitigate reliability concerns and reduce the cost of upgrading the nation's power system infrastructure.

Figure 7



Source: U.S. EPA (with city locations added by M.J. Bradley & Associates)

III. EPA, DOE, FERC AND STATE UTILITY REGULATORS HAVE THE TOOLS TO MODERATE IMPACTS ON THE ELECTRIC INDUSTRY AND MANAGE ELECTRIC SYSTEM RELIABILITY.

A. Statutory, Regulatory and Market Safeguards Exist To Mitigate Risks of Retirement On Reliability

Assorted risk management procedures under the CAA, the Federal Power Act ("FPA") and other statutes provide EPA, DOE, FERC, and the President tools to moderate potential impacts on electric system reliability. The procedures serve as a bridge, if necessary, to a permanent solution, helping ensure reliability while minimizing exposure to harmful air pollutants. EPA also has the authority to develop cost-effective regulatory approaches, such as the emissions trading mechanism proposed in the Transport Rule, that will enable greater compliance flexibility and flexibility in managing potential reliability issues.

In addition to the EPA's and President's authority to extend deadlines for installation of pollution controls described in Section II B, where necessary to maintain electric system reliability, DOE has the power under Section 202(c) of the FPA to override CAA-derived control requirements in limited emergency circumstances. In such emergency situations, including extended periods of insufficient power supply as a result of shortage of electric facilities, DOE has the discretion to issue unit-specific orders designed to maximize CAA compliance and minimize health risks.

Two examples of DOE's exercise of this authority illustrate the point. In 2003, the Secretary of Energy ordered energizing a new underwater cable connecting New Haven, Connecticut to Long Island, which had previously been constructed but remained inoperable due to legal actions appealing permits. Citing August 2003's massive electric service outage, the Secretary invoked his authority to alleviate the reliability emergency.[58]

DOE's actions related to the Potomac River plant serving Washington, DC provide another example. In 2005, the plant's owner, Mirant, had decided to shut down all five generating units at its Potomac River plant located outside Washington, DC. The DC Public Service Commission requested that DOE

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[58] DOE, *Order No. 202-03-2*, August 28, 2003. "I hereby determine that an emergency continues to exist in the Northeast United States due to a shortage of electric energy, a shortage of facilities for [...] the transmission of electric energy and other causes. [...] On August 14, 2003, the Northeast and Upper Midwest areas in the United States, as well as portions of Canada, experienced the largest electric transmission grid failure and electric service outage ever to occur in North America. Tens of millions of people were affected by this outage, and it presented profound risks to the public health and safety throughout the affected areas. [...] Only hours after the outage occurred, and after considering the unanimous recommendation of the North American Electric Reliability Council, the New York Independent System Operator (NYISO), ISO New England, Inc. (ISO-NE), and electric utilities in both New York and Connecticut in support of the issuance of an emergency order, I issued an order directing the NYISO and ISO-NE to require the Cross-Sound Cable Company, LLC (CSC) to operate the Cross-Sound Cable and related facilities as necessary to alleviate the disruptions in electric transmission service. The Cable was energized a short time thereafter."

issue an emergency order directing Mirant to continue to operate the units, as their shutdown would have "immediate" and "drastic" effects on DC's electric system reliability. In conjunction with the EPA, which required Mirant to enter into a consent decree, DOE issued an Order[59] requiring Mirant to operate the plants under specific and limited circumstances tailored to relieve the risk of a DC area blackout, while avoiding to the full extent possible exceedances of federal air quality standards.

The well-established consent decree template, as used to address the Potomac River situation, provides EPA yet another tool to synthesize reliability and environmental concerns. By restricting a unit to operate for reliability purposes only, pending completion of any required transmission upgrades or replacement

[Page 23]
generation, such consent decrees can maintain reliability while minimizing adverse environmental impacts to the fullest extent possible.

Many regional wholesale competitive markets also have well-established forward capacity markets such as PJM's Reliability Pricing Model and New England's Forward Capacity Market, which are approved by FERC and overseen by independent market monitors, to facilitate and provide advanced notice of the retirement of inefficient units while maintaining reliability. Reliability impact studies are conducted for units that have announced

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[59] DOE, *Order No. 202-05-03*, December 20, 2005.

retirement or fail to clear the forward capacity auctions, and those identified as being needed for reliability may continue to operate past their planned retirement date pursuant to "reliability must run" ("RMR") agreements. To help ensure reliability while minimizing adverse environmental impacts, the RMR agreements can provide the units operate only to maintain reliability. For example, Exelon Generation recently coordinated with PJM and the Pennsylvania Department of Environmental Protection ("PA DEP") to negotiate a consent decree and operating procedures related to an RMR agreement for its two retiring coal units, which require the units operate for reliability purposes only.[60]

In addition to these established ISO/RTO procedures, advance analysis in the long range reliability planning processes should lead to rational and timely investments in new transmission that will mitigate any service reliability issues associated with future generation retirements. The local transmission owners currently play an important supplemental role in accomplishing this objective. For example, Commonwealth Edison ("ComEd"), the local transmission owner in Chicago, proactively filed an

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[60] *Commonwealth of Pennsylvania Department of Environmental Protection v. Exelon Generation Company, LLC.*, No. 382 MD 2010 (Pa. Cmmw. April 16, 2010) included in *Operating Procedures for Cromby Generating Station Unit No. 2 and Eddystone Generating Station Unit No. 2 as Required for Reliability Purposes* at Appendix 1, http://pjm.com/planning/generationretirements/~/media/planning/gen-retire/must-run-operating-procedures.ashx (accessed August 6, 2010).

application with the Illinois Commerce Commission[61] seeking permission to enhance its transmission system. In its application, ComEd noted the identified upgrades would be required to maintain system reliability in the event that two of Midwest Generation's at-risk coal units, Fisk and Crawford, were to retire.[62]

Procedures also exist to protect electric system reliability in regions where coal plants are not part of an organized wholesale competitive market, but are owned by vertically-integrated utilities in traditionally regulated monopoly regimes. Generators regulated by state regulatory commissions have a legal obligation to reliably serve their customers, and to conduct long range resource planning. Typically, generators will have many options to meet their statutory obligation to serve including, but not limited to: (1) investing in existing plants; (2) building new plants; (3) decreasing load through DR and EE programs; (4) building transmission; or (5) a prudent combination of all those tools. Too, state regulators may adopt ratemaking policies to encourage such actions, including ones that address utilities' financial disincentives where aggressive EE and DR programs would otherwise produce lower revenues.

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[61] Commonwealth Edison Company, *Application for authorization under Section 4-101 of the Illinois Public Utilities Act ("Act"), 220 ILCS § 5/4-101, or alternatively, for a Certificate of Public Convenience and Necessity, pursuant to Section 8-406 of the Act, to install, operate and maintain two new 345,000 volt electric transmission lines in Cook County, Illinois*, No. 10-0385 (Ill. Cir. June 11, 2010).

[62] Direct Testimony of Thomas W. Leeming, p. 2, Lines 25-35.

As such, FERC and other relevant agencies have a number of tools available to moderate the impacts of air emission regulations, while maintaining reliability and minimizing adverse environmental impacts. Moreover, EPA is also developing new water regulations under Section 316(b) of the Clean Water Act ("CWA"), new waste regulations, and greenhouse gas regulations affecting the electric power sector. EPA should consider efficiently coordinating these rules as it moves forward with its rulemakings to avoid possible reliability concerns.

[Page 24]
IV. CONCLUSION

Current industry practice and a review of applicable system data indicate the industry is well-positioned to respond to EPA's mission to "help millions of Americans breathe easier and live healthier" without threatening electric reliability. Generation plant capacity and availability, consumption levels and patterns, and transmission capacity and use must all be considered when judging the reliability impacts of environmental regulatory action.

The existing substantial excess capacity, the industry's proven track record to timely construct new generation and to efficiently coordinate the scheduling of planned outages, together with capacity upgrades, transmission enhancements, "smart grid" investments, fuel conversions, DR, and EE, should mitigate reliability concerns.

The industry has already successfully employed these various strategies to reliably meet customers' energy needs while reducing environmental impacts,

and it will continue to do so in response to EPA's new regulations. As a final backstop, existing statutory, market and regulatory safeguards will facilitate the retirement of inefficient units, and an orderly transition to cleaner, more efficient generation.

* * *

EXHIBIT 4

To Comments Of Exelon Corporation On Docket ID No. EPA-HQ-OAR-2009-0234 and Docket ID No.EPA-HQ-OAR-2011-0044 76 Fed. Reg. 24,976 (May 3, 2011)

James E. Staudt & M.J. Bradley & Associates LLC, "Control Technologies to Reduce Conventional and Hazardous Air Pollutants From Coal-Fired Power Plants," prepared for NESCAUM (March 31, 2011) ("NESCAUM Report")

* * *

[Page 1]

Executive Summary

To implement requirements adopted by Congress in the federal Clean Air Act (CAA), the U.S. Environmental Protection Agency (EPA) is developing new rules to reduce air pollution from fossil fuel power plants. Power plants that burn coal will bear a large responsibility for reducing their emissions further, as the majority of air pollutants from the electric generation sector come from coal combustion.

The major rules addressing power plant pollution that EPA recently proposed are the Clean Air Transport Rule (Transport Rule), and the National Emission Standards for Hazardous Air Pollutants from Electric Utility Steam Generating Units (Air Toxics Rule). The Transport Rule will address the

long-range interstate transport of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) in the eastern United States. Both these types of pollutants contribute to formation of small particles ("fine particulates") in the atmosphere that can be transported long distances into downwind states. These small particles can be inhaled deep into the lungs, causing serious adverse health impacts. Nitrogen oxides also contribute to the formation and long-range transport of ground-level ozone, another pollutant with significant health impacts. The Air Toxics Rule will address emissions of hazardous air pollutants (HAPs) such as mercury, lead, arsenic, along with acid gases such as hydrogen chloride and hydrogen fluoride and organic air toxics (e.g., dioxins and furans). HAPs are chemical pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive problems or birth defects, and that adversely affect the environment.

These regulations will require coal-fired power plants that have not yet installed pollution control equipment to do so and, in some cases, will require plants with existing control equipment to improve performance.

Over the last several decades, state and federal clean air rules to address acid rain and ground-level smog led to power plant owners successfully deploying a range of advanced pollution control systems at hundreds of facilities across the country, providing valuable experience with the installation and operation of these technologies. In addition, many states adopted mercury reduction requirements in the absence of federal rules, leading to new controls

and significant reductions of this air toxic from a number of coal power plants over the past several years. This has provided industry with a working knowledge of a suite of air pollution control devices and techniques that can comply with EPA's proposed Transport Rule and Air Toxics Rule.

This report provides an overview of well-established, commercially available emission control technologies for SO_2 and NO_x, and HAPs, such as mercury, chromium, lead and arsenic; acid gases, such as hydrogen chloride and hydrogen fluoride; dioxins and furans; and other toxic air emissions.

The key findings of the report include:

- **The electric power sector has a range of available technology options as well as experience in their installation and operation that will enable the sector to comply with the Transport Rule and the Air Toxics Rule.**

    - The electric power sector has long and successful experience installing many of the required pollution control systems.

[Page 2]

    - The first flue gas desulfurization (scrubber) system was installed in 1968 and more than 40 years later, the plant is still in operation and undergoing a performance upgrade.

    - To reduce SO_2 emissions, about 60 percent of the nation's coal fleet has already

installed scrubber controls, the most capital intensive of the pollution control systems used by coal-fired power plants.

- About half of the nation's coal fleet has already installed advanced post-combustion NO_x controls, with the first large-scale coal-fired selective catalytic reduction (SCR) system on a new boiler in the U.S. placed in service in 1993 and the first retrofit in the U.S. placed in service in 1995.

➢ **Modern pollution control systems are capable of dramatically reducing air pollution emissions from coal-fired power plants.**

- Although scrubbers installed in the 1970s and 1980s typically obtained 80-90 percent SO_2 removal, innovation has led to modern systems now capable of achieving 98 percent or greater removal.

- SCR can achieve greater than 90 percent NO_x removal.

- Coal-fired power plants, equipped with baghouse systems, report greater than 90 percent removal of mercury and other heavy metals.

➢ **Pollution controls that significantly reduce mercury emissions from coal-fired power plants have already been installed, demonstrated, and in operation at a**

significant number of facilities in the United States. This experience demonstrates the feasibility of achieving the mercury emissions limits in the proposed Air Toxics Rule.

- In 2001, under cooperative agreements with the Department of Energy, several coal plant operators started full-scale testing of activated carbon injection (ACI) systems for mercury control.

- Since 2003, many states have led the way on mercury control regulations by enacting statewide mercury limits for coal power plants that require mercury capture rates ranging from 80 to 95 percent. Power plants in a number of these states have already installed and are now successfully operating mercury controls that provide the level of mercury reductions sought in EPA's proposed Air Toxics Rule.

- At present, about 25 units representing approximately 7,500 MW are using commercial technologies for mercury control. In addition, the Institute of Clean Air Companies (ICAC), a national association of companies providing pollution control systems for power plants and other stationary sources, has reported about 55,000 MW of new bookings.

[Page 3]

➢ **A wide variety of pollution control technology solutions are available to cost-**

effectively control air pollution emissions from coal-fired power plants, and many technologies can reduce more than one type of pollutant.

- A variety of pollution control solutions are available for different plant configurations.
    - The air pollutants targeted by the Transport Rule and the Air Toxics Rule are captured to some degree by existing air pollution controls, and, in many cases, technologies to control one pollutant have the co-benefit of also controlling other pollutants. For example, scrubbers, which are designed to control SO_2, are also effective at controlling particulate matter, mercury, and hydrogen chloride.
    - Dry sorbent injection (DSI) has emerged as a potential control option for smaller, coalfired generating units seeking to cost-effectively control SO_2 and acid gas emissions.
    - As highlighted below in Table ES-1, because of these "co-benefits," in many cases it may not be necessary to add separate control technologies for some pollutants.

[Page 3 cont.]

Table ES-1. Control Technology Emission Reduction Effect

	SO2	NOx	Mercury (Hg)	HCl	PM	Dioxins/ Furans
Combustion Controls	N	Y	C	N	N	Y
SNCR	N	Y	N	N	N	N
SCR	N	Y	C	N	N	C
Particulate Matter Controls	N	N	C	N	Y	C
Low Sulfur Fuel	Y	C	N	C	N	N
Wet Scrubber	Y	N	C	Y	C	N
Dry Scrubber	Y	N	C	Y	C*	N
DSI	Y	C	C	Y	N	C
ACI	N	N	Y	N	N	Y

N = Technology has little or no emission reduction effect

Y = Technology reduces emissions

C = Technology is normally used for other pollutants, but has a co-benefit emission reduction effect

* When used in combination with a downstream particulate matter control device, such as a baghouse

[Page 3 cont.]

- **The electric power sector has a demonstrated ability to install a substantial number of controls in a short period of time, and therefore should be able to comply with the timelines of the proposed EPA air rules.**

    - Between 2001 and 2005, the electric industry successfully installed more than 96 gigawatts (GW) of SCR systems in response to NO_x requirements.

    - In response to the Clean Air Interstate Rule (CAIR), about 60 GW of scrubbers and an additional 20 GW of SCR were brought on line from 2008 through 2010. Notably, most companies were "early movers," initiating the installation process before EPA finalized its rules.

[Page 4]

    - Available technologies that are less resource and time-intensive will provide additional compliance flexibility. For example, DSI and dry scrubbing technology design and installation times are approximately 12 and 24 months, respectively.

- **The electric power sector has access to a skilled workforce to install these proven control technologies.**

- In November 2010, ICAC sent a letter to U.S. Senator Thomas Carper confirming the nation's air pollution control equipment companies

repeatedly have successfully met more stringent NO_x, SO_2 and mercury emission limits with timely installations of effective controls and are well prepared to meet new EPA requirements.

- Also in November 2010, the Building and Construction Division of the AFL-CIO sent a letter to Senator Carper indicating that "[t]here is no evidence to suggest that the availability of skilled manpower will constrain pollution control technology development."

- Actual installation of pollution control equipment far exceeded EPA's earlier estimate of industry capability that it made during the Clean Air Interstate Rule (CAIR) rulemaking.

- In response to CAIR, boilermakers increased their membership by 35 percent in only two years (between 1999 and 2001) to meet peak labor demand.

In summary, a range of available and proven pollution control technologies exists to meet the requirements of EPA's proposed Transport Rule and Air Toxics Rule. In many cases, these technologies, some of which have been operating for decades, have a long track record of effective performance at many coal-fired power plants in the U.S.

The electric power sector has shown that it is capable of planning for and installing pollution controls on a large portion of the nation's fossil fuel generating capacity in a relatively short period of time.

Suppliers have demonstrated the ability to provide pollution control equipment in a timely manner, and the skilled labor needed to install it should be available to meet the challenge as well. Examples of successful pollution control retrofits are provided throughout this report.

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EXHIBIT 7

To Comments Of Exelon Corporation On Docket ID No. EPA-HQ-OAR-2009-0234 and Docket ID No.EPA-HQ-OAR-2011-0044 76 Fed. Reg. 24,976 (May 3, 2011)

URS, "Assessment of Technology Options Available to Achieve Reductions of Hazardous Air Pollutants," (April 5, 2011) ("URS Technology Assessment")

* * *

[Page 1]

Executive Summary

This report[1] describes the results of an assessment conducted by URS Corporation (URS) to evaluate the availability of pollution control technologies to meet the requirements of the proposed National Emission Standards for Hazardous Air Pollutants (NESHAP) for Utility Electric Generating Units ("EGUs") (the "Toxics Rule"). This assessment was designed to answer the ultimate question of whether control technologies are available that will equip EGUs to meet the emission limitations the Environmental Protection Agency (EPA) has proposed, regardless of current configuration. URS identified proven, commercially

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[1] This report was prepared by URS Corporation for Exelon Corporation.

available control technologies that will enable EGUs to achieve compliance with the Toxics Rule, given adequate investment by the owners. In the event that an EGU requires the installation or upgrade of control equipment, the technologies available typically require less than three years to install after detailed design and permitting is complete.

To begin, URS identified a number of typical control equipment configurations present at existing EGUs. An assessment was performed to evaluate additional control technologies appropriate for those configurations that would enable EGUs to comply with the Toxics Rule emission limitations on hazardous air pollutants ("HAP"). URS consulted its own experience and database of pollution control technologies and reviewed published literature, conference proceedings, expert analysis and procurement information regarding the availability, cost and efficacy of numerous available control technologies. URS applied this information and its own experience to evaluate the menu of control options that would be available to EGUs of different configurations, and to rank those options. This analysis took into account the performance, maturity and number of existing commercial installations of the control technologies. While special cases may exist, this analysis demonstrates that the Toxics Rule emission limitations are generally achievable through the application of proven, commercially available technologies, regardless of the starting configuration of the facility.

Assuming EPA signs the final Toxics Rule as scheduled on November 16, 2011, the rule will not be

effective until early 2012, or 60 days after it is published in the Federal Register. EGUs will not be required to comply with the Toxics Rule until three years after the effective date, or early 2015 – nearly four years after proposal. To the extent that existing facilities require additional control technology to comply with the Toxics Rule, the technology is known, available and the industry has demonstrated its ability to install and to operate these controls.

[Page 2]

The controls that will be most commonly needed, such as activated carbon injection (for mercury control) or dry sorbent injection (for SO_3 control on bituminous fired plants and acid gas control at some western sub-bituminous fired EGUs) typically require less than eighteen months to install once permitting is completed. Barring unreasonable permitting or supply chain delays, EGU owners who act promptly will be able to complete such low capital upgrades by the compliance date. Facilities requiring high capital upgrades such as the addition of wet FGDs will face longer installation times. Owners of EGUs requiring such additions will need to select technologies and contractors and to file permit applications promptly to meet the 2015 compliance deadline. For those facilities facing unique challenges in completing necessary upgrades by 2015, EPA has indicated that it will provide extensions of up to one year.

[Page 3]

1.0 Introduction

In performing this assessment, URS considered the emissions limitations proposed by EPA in the

Toxics Rule, reviewed relevant commercially available control technologies and evaluated seven hypothetical configurations of existing control equipment to determine whether such facilities could be brought into compliance with the proposed Toxics Rule emission limitations. It was concluded that: 1) in many instances, no additional controls would be required; 2) where additional controls would be necessary, the most common top-ranked control technologies can typically be installed in less than 24 months; and 3) in all other instances considered in this assessment, the top-ranked control technology can typically be installed in less than 36 months after detailed design and permitting is complete.

2.0 Technology Survey

2.1 EPA's Proposed Emission Limitations

In the Toxics Rule, EPA proposes emissions limitations for five different sub-categories of EGUs. Coal-fired EGUs are divided into lignite, non-lignite and integrated gasification/ combined cycle ("IGCC") sub-categories. Oil-fired EGUs are divided into solid fuel (petroleum coke) and liquid fuel sub-categories. EPA has proposed emission limitations for mercury, hydrogen chloride ("HCl") and total particulate matter ("PM") for all coal-fired EGU subcategories and the solid fuel oil sub-category, with HCl being a surrogate for all acid gases and PM being a surrogate for non-mercury HAP metals. For liquid oil-fired EGUs, EPA has proposed limits on total HAP metals (including mercury), HCl and hydrogen fluoride ("HF"). EPA has proposed to regulate dioxins/furans and other organic HAPs for all sub-categories through work practice standards rather than

numerical emission limitations. EPA has also proposed a number of alternative compliance methods. For example, coal-fired EGUs may use sulfur dioxide ("SO_2") as a surrogate for acid gases in certain circumstances, and may test for total non-mercury HAP metals or ten individual HAP metals in lieu of complying with the PM limitation.

2.2 URS' Technology Survey

URS conducted a review of commercially-available air quality control ("AQC") technologies that may be employed by coal- and oil-fired EGUs in order to meet emission limitations proposed by EPA in the Toxics Rule. This technology survey presents control technologies for Mercury, HCl, and PM, the default emission limitations in the Toxics Rule for

[Page 4]
coal-fired EGUs and solid fuel oil-fired EGUs.[2] Although EPA proposed different emission limitations for liquid fuel oil-fired EGUs, the technologies available for controlling PM and HCl at other EGUs would control total HAP metals and HF (as well as HCl) at liquid fuel oil-fired EGUs.

To conduct the control technology assessment, URS utilized internal information on air quality control technologies, as well as information from published literature and conference proceedings, discussions with technology experts, and procurement information associated with some technologies. For each pollutant category, air quality control technologies were evaluated for their ability

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[2] URS did not specifically address the applicability of any particular technology to IGCC units.

to achieve sufficient performance levels. Although costs were not a primary factor in the selection of appropriate technologies, they were considered when comparing different technologies with similar expected performance levels. The multi-pollutant nature of various technologies was also considered, as some processes would be expected to effectively remove pollutants from a number of potential HAP categories, allowing a holistic approach to achieving compliance with the Toxics Rule. Through this analysis, a ranking of available control technologies was developed that takes into account cost, maturity and the ability to treat multiple HAPs. This assessment did not consider possible technologies for controlling dioxin/ furan emissions or organic HAPs. Under the proposed Toxics Rule, these HAPs are to be controlled through work practice standards.

The analysis demonstrates that there is a range of control technologies available to EGUs requiring additional levels of control for mercury, HCl or PM. These technologies are proven and mature, and in fact are already installed at many EGUs. Many of the available technologies involve relatively low capital retrofits that typically require less than eighteen months to install. Some technologies, such as wet or dry scrubbers, have longer installation times and EGU owners requiring such additions will need to move more rapidly to meet the 2015 compliance deadline.

2.3 Assumptions Regarding Existing Sources

URS assessed AQC technologies for expected performance, cost, and schedule to construct at power plants of several different configurations. It

should be noted that for any particular facility, technology assessments must be conducted on a site-specific basis, taking into account the plant's existing equipment, current operating scenarios, physical layout and balance of plant considerations, as well as economic and long-term planning considerations. For the purposes of this study, several common configurations of AQC technology already in place at

[Page 5]
existing fossil-fuel fired facilities were identified to address expected need for additional controls to reduce the emissions of toxic air pollutants. These hypothetical configurations consist of one or a combination of control technologies for PM, SO_2 or oxides of nitrogen ("NO_x").

The most common PM control technologies are fabric filters ("FFs") and electrostatic precipitators ("ESPs"). The most common SO_2 controls are flue gas desulfurization ("FGD") systems (commonly called "scrubbers"), which can be either wet ("FGDw") or dry ("FGDd"). The most common NO_x controls are selective catalytic reduction ("SCR") systems.

The potential need for additional controls to comply with the Toxics Rule was evaluated for seven different hypothetical configurations of AQC technology at existing EGUs, as presented in Table 2-1. The objective of the assessment was to present the most plausible technologies for each plant configuration to achieve the HAP emission limitations. This analysis does not indicate that all plant configurations will need additional controls; nor does it imply that any particular controls installed at a specific plant will unequivocally meet

the emission limitations proposed in the Toxics Rule. The analysis is intended as an overview of commercially available, proven technologies that may potentially be employed in order to lower emissions of the targeted HAP species for a given plant configuration. The analysis took into account cost as well as the performance, maturity level, and number of existing commercial installations of each technology. Selected technologies included different control processes that could be implemented for different fuel types, including opportunities for fuel switching. Additionally, the ability of certain technologies to control multiple HAPs was considered when making final selections.

2.4 Summary of Survey Results

URS identified several alternative control strategies that could be deployed where these hypothetical configurations will likely require additional control for PM, HCl and mercury. Up to four different technologies were identified for each scenario, each of which would provide the additional level of control required. Those technologies were then ranked according to the criteria described above. Table 2-1 lists several alternatives for each configuration requiring additional control. Each facility would choose one of these alternatives to achieve compliance with the Toxics Rule, based on the site-specific conditions at that facility. As the table reflects, many facilities with existing PM and SO_2 controls may need no additional controls to meet the PM and HCl limits in the Toxics Rule,

respectively.[3] However, if the controls at such facilities

[Page 6]
are already at their maximum capacity or face other operational challenges, these facilities may indeed need additional controls for PM or HCl as well. Suggestions are provided for upgrades and add-on controls for these outlier plants in the discussion in Section 3.0.

In Table 2-1, configurations that are unlikely to need additional controls to comply with the Toxics Rule are shaded in green. Those likely to require additional controls that can be installed in no more than 24 months are shaded in blue. Those likely to require additional controls that can be typically installed in 36 months (but require more than 24 months) are shaded in yellow. Installation times for new controls are not cumulative. Rather, EGU owners installing multiple control technologies would schedule installation of those controls, and any ancillary modifications to the plant, during the same planned outage, or a coordinated series of outages, provided all controls could be installed prior to the deadline for compliance with the Toxics Rule. Nonetheless, if a particular control cannot be installed prior to this deadline, it is probable that controls necessary for other HAPs would be installed separately, because these control technologies are not, by and large, interdependent.

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[3] These configurations are noted in the table as "no additional control needed."

Section 3.0 of this report provides brief discussions of the rationale behind the various technology selections for each of the hypothetical configurations considered. For each configuration, the report provides strategies for controlling PM, HCl and mercury. Appendix A presents further information on the technologies discussed in this report, including each technology's maturity; the number of commercial installations, if known, the technology's expected performance; capital and operating costs; and the typical schedule for design, installation, and startup.

Table 2-1. Pollution Control Options for Coal- and Oil-Fired Power Plants[4]

Existing Configuration	Control Options to Achieve Toxics Rule Emission Limitations		
	PM	HCl	Hg
Fabric Filter only (§ 3.2)	*No additional control needed*	1) FGDd; or 2) FGDw; or 3) Dry Sorbent Injection;[5] or 4) Coal switch	1) ACI with SO_3 control; or 2) FGDw with re-emission additives; or 3) Combustion Modification; or 4) Coal switch
Fabric Filter with Wet Flue Gas Desulfurization (§ 3.3)	*No additional control needed*	*No additional control needed*	1) ACI with SO_3 control; or 2) FGD additives; or 3) Bromide addition
Fabric Filter with Dry Flue Gas Desulfurization (§ 3.4)	*No additional control needed*	*No additional control needed*	1) ACI with SO_3 control; or 2) Bromide addition
Fabric Filter with Dry Flue Gas Desulfurization and Selective Catalytic Reduction (§ 3.5)	*No additional control needed*	*No additional control needed*	1) ACI with SO_3 control; or 2) Bromide addition; or 3) Coal switch
Electrostatic Precipitator with Wet Flue Gas Desulfurization and Selective Catalytic Reduction (§ 3.6)	1) ESP upgrade; or 2) Scrubber upgrade; or 3) Toxecon; or 4) Wet ESP	*No additional control needed*	1) ACI with SO_3 control; or 2) Bromide addition; or 3) FGDw re-emission additives; or 4) Toxecon
Electrostatic Precipitator only (§ 3.7)	1) ESP upgrade; or 2) Toxecon; or 3) Wet ESP; or 4) FGDw	1) FGDd/FF; or 2) Toxecon w/ Dry Sorbent Injection; or 3) Coal switch; or 4) FGDw	1) Toxecon; or 2) ACI with SO_3 control; or 3) FGDw + Bromide; or 4) Coal switch
Electrostatic Precipitator with Wet Flue Gas Desulfurization (§ 3.8)	1) ESP upgrade; or 2) FGDw upgrade; or 3) Toxecon	*No additional control needed*	1) ACI with SO_3 control; or 2) Bromide addition; or 3) FGDw re-emission additives; or 4) Toxecon

[4] Green highlighting indicates that additional controls are unlikely to be necessary to achieve Toxics Rule emission limitations. Blue highlighting indicates that the top-ranked control technology has installation times of 24 months or less, after permitting. Yellow highlighting indicates that the top-ranked control technology has typical installation times of more than 24 months but less than 36 months, after permitting.

[5] Dry sorbent injection includes Trona, hydrated lime, SBS and other reagents.

[Page 8]

3.0 Analysis of Control Alternatives

3.1 Overview

With adequate investment, it should be possible for virtually any EGU to comply with all emission limits under the Toxics Rule, but the required strategy for meeting these limits will depend on each plant's existing control configuration. The following sections present seven typical air pollution control configurations at fossil-fuel fired power plants, as listed in Table 2-1. Each regulated HAP (or surrogate) is discussed in terms of the plant configuration and likely controls that may be necessary or useful in achieving EPA's proposed mercury and air toxics limits. Through the reasoning that is presented in the sections below, technologies have been selected as the most likely to assist in meeting EPA's proposed mercury and air toxic standards, as presented in Table 2-1. Technologies discussed in this section are all commercially available technologies with a history of demonstrated performance, and each is capable of achieving compliance with the Toxics Rule. It is acknowledged that site specific factors will impact the ultimate performance of any AQC technology at a given plant. Additional technologies in the developmental stages may be available and have not been included in the scope of this survey. For further detail on these technologies see Appendix A.

3.2 Fabric Filter Configuration

3.2.1 Particulate Matter (PM)

A properly sized and functional FF should provide adequate PM control to comply with the

Toxics Rule. If a facility is in need of additional removal, one option would be to add a wet scrubber after the baghouse to remove additional PM as well as HCl. Toxecon could also be added (downstream carbon injection and baghouse) if multi-pollutant control is desired, as this system provides not only additional PM control, but mercury control as well.

3.2.2 Hydrochloric Acid (HCl)

Plants equipped with a properly sized and functional fabric filter capable of controlling PM emissions and with a sufficient additional margin could adequately control emissions of HCl with the installation of a dry FGD system. FGDd would be effective for relatively high HCl content and, for this configuration, would be less costly than FGDw. However, additional PM emissions can be expected with the operation of an FGDd system; therefore, for units with a FF that is not capable of controlling additional PM loadings, a wet FGD would be an effective way to control both HCl and PM.

[Page 9]

For plants burning bituminous coal, switching to a western sub-bituminous coal would appreciably reduce HCl emissions. If coal substitution alone does not achieve compliance for these plants, dry sorbent injection will be sufficient to treat the reduced load of HCl. For plants already burning PRB coal and configured with an efficient FF, dry sorbent injection can be expected to reduce HCl emissions sufficiently to meet the Toxics Rule emission standard, and will be significantly less costly than a wet or dry scrubber.

3.2.3 Mercury (Hg)

For plants equipped with a properly sized and functional fabric filter capable of controlling PM emissions and with a sufficient additional margin, an activated carbon injection (ACI) system will provide adequate Hg control. FFs usually respond well to ACI for Hg removal, assuming the FF can handle the additional PM loading resulting from the operation of the ACI. However, fly ash sales may be impacted by ACI installation upstream of the FF due to increased carbon levels in the collected fly ash. Additionally, under this configuration, control of SO_3, which tends to hinder the effectiveness of ACI Hg removal, may be necessary for effective operation of ACI when burning high sulfur coal.

If mercury re-emissions from the wet FGD system cause the EGU to exceed the Toxics Rule emission limitation, the use of scrubber additives to reduce the re-emissions may be more cost-effective than ACI.

If further Hg control is needed, using Low NO_x Burners or increasing their NO_x removal performance can lead to higher Loss on Ignition (LOI) to the fly ash, and better Hg removal.

Some plants firing bituminous coal might be challenged to achieve Hg emission limitations due to SO_3 interference with sorbent-based mercury control processes. Plants firing lignite (particularly Texas lignite) will require high levels of removal in order to comply with the Toxics Rule. However, in both cases, a switch to western sub-bituminous coal could appreciably lower mercury emissions. In the case of bituminous coals this would be through decreasing

flue gas SO_3 concentrations, and thus increasing the performance of ACI for Hg control. For Texas lignite coals, Hg emissions would likely be lowered due to significantly lower fuel Hg concentrations, as well as moderate improvement in ACI performance.

[Page 10]

3.3 Fabric Filter and Wet FGD Configuration

3.3.1 Particulate Matter (PM)

Plants equipped with FF and FGDw are unlikely to require additional controls to meet the PM emission limitation in the Toxics Rule. If additional control is required, a plant could upgrade either its fabric filter or scrubber, or both, to achieve the PM emission limitation.

3.3.2 Hydrochloric Acid (HCl)

Plants equipped with FF and FGDw are unlikely to require additional controls to meet the HCl emission limitation in the Toxics Rule.

3.3.3 Mercury (Hg)

For plants equipped with a properly sized and functional fabric filter capable of controlling PM emissions with a sufficient additional margin, an activated carbon injection (ACI) system will provide adequate Hg control. FFs usually respond well to ACI for Hg removal, assuming the FF can handle the additional PM loading resulting from the operation of the ACI. However, SO_3 control may be necessary for effective operation of ACI when burning high sulfur coal.

If mercury re-emissions from the wet FGD system cause the EGU to exceed the Toxics Rule

emission limitation, the use of scrubber additives may be able to reduce re-emission of mercury more cost-effectively than ACI.

Finally, although less effective without a selective catalytic reduction (SCR) system, bromine addition could be sufficient for trimming emissions at EGUs firing low sulfur coal if the Hg emission rate needs only small incremental improvement.

3.4 Fabric Filter-Dry FGD Configuration

3.4.1 Particulate Matter (PM)

Plants equipped with FF and FGDd are unlikely to require additional controls to meet the PM emission limitation in the Toxics Rule. If additional control is required, a plant could upgrade either its fabric filter or scrubber, or both, to achieve the PM emission limitation.

[Page 11]

3.4.2 Hydrochloric Acid (HCl)

Plants equipped with FF and FGDd are unlikely to require additional controls to meet the HCl emission limitation in the Toxics Rule. However, if needed, a dry sorbent injection system would provide a low capital option to trim emissions.

3.4.3 Mercury (Hg)

For plants equipped with a properly sized and functional fabric filter capable of controlling PM emissions with a sufficient additional margin, an Activated Carbon Injection (ACI) system will provide adequate Hg control. FFs usually respond well to ACI for Hg removal, assuming the FF can handle the additional PM loading resulting from the operation

of the ACI. However, SO_3 control may be necessary for effective operation of ACI when burning high sulfur coal.

Finally, although less effective without a selective catalytic reduction (SCR) system, bromide addition could be sufficient for trimming emissions at EGUs firing low sulfur coal if the Hg emission rate needs only small incremental improvement.

3.5 SCR-FGDd-FF Configuration

3.5.1 Particulate Matter (PM)

Plants equipped with SCR, FF and FGDd are unlikely to require additional controls to meet the PM emission limitation in the Toxics Rule. If additional control is required, a plant could upgrade either its FF or scrubber, or both, to achieve the PM emission limitation.

3.5.2 Hydrochloric Acid (HCl)

Plants equipped with SCR, FF and FGDd are unlikely to require additional controls to meet the HCl emission limitation in the Toxics Rule. If necessary, removal rates would be improved by either upgrading the scrubber or installing a dry sorbent injection system.

3.5.3 Mercury (Hg)

For plants equipped with a properly sized and functional fabric filter capable of controlling PM emissions with a sufficient margin, an activated carbon injection (ACI) system will provide adequate Hg control. FFs usually respond well to ACI for Hg removal, assuming the FF can handle the additional PM loading resulting from the operation of the ACI.

However, SO_3 control may be necessary for effective operation of ACI when burning high sulfur coal.

[Page 12]

Removal rates of Hg from bromide addition are high in combination with the SCR, especially for PRB coal, and could also provide polishing capability for bituminous coals that require only incremental improvements in removal. However, the SCR, FGDd, FF configuration is not typical for plants firing bituminous coal. If installed on a bituminous coal plant, it is possible that mercury control performance could be constrained by elevated SO_3 levels. A switch to Western sub-bituminous coal would improve the performance of the plant's various mercury controls as well as yield acid gas emission reductions.

3.6 SCR-ESP-Wet FGD Configuration

3.6.1 Particulate Matter (PM)

The compliance strategy for PM under this configuration will depend on the performance of existing controls. Assuming the existing ESP does not provide adequate control to meet the Toxics Rule emission limitation, the first option to provide additional control would be an upgrade of the ESP, the scrubber mist eliminator, or both. Alternatively, a wet ESP may be installed. Toxecon could also be added downstream of the existing ESP if multi-pollutant control is desired.

3.6.2 Hydrochloric Acid (HCl)

Plants equipped with a high-efficiency wet FGD system are unlikely to require additional controls to meet the HCl emission limitation in the Toxics Rule. If additional removal is needed, removal efficiencies

could be improved by one or more of the FGD upgrades described in Appendix A.

3.6.3 Mercury (Hg)

The Hg control strategy under this configuration would depend on the fuel being fired. The primary choice for plants firing bituminous coal would likely be ACI with additional SO_3 control technology; some plants with this configuration might not require any additional mercury control. For plants firing low-sulfur fuels, the primary choice would likely be bromine addition. For plants requiring additional PM control, or desiring Hg removal upstream of the FGD system, Toxecon with activated carbon injection would likely be the best control strategy. Under this configuration, scrubber re-emissions additives may be required to control Hg emissions in conjunction with other control technology, depending on mercury removal performance of the wet FGD. 13

3.7 ESP Only Configuration

3.7.1 Particulate Matter (PM)

The compliance strategy for PM under this configuration will depend on the performance of existing controls. Assuming the existing ESP does not provide adequate control to meet the Toxics Rule emission limitation, the first option for additional control would be an upgrade of the ESP. Alternatively, a wet ESP may be installed. Toxecon could also be added downstream of the existing ESP if multi-pollutant control is desired. In some cases, particularly plants burning bituminous fuels, a wet FGD may be installed if additional SO_2 control is also desired.

3.7.2 Hydrochloric Acid (HCl)

A dry FGD system will provide effective control for relatively high HCl content, but may require installation of a fabric filter to control the additional particulate loadings dry FGD would add. A dry FGD system is likely to be more cost effective than a wet FGD, if switching to a FF to handle the additional particulate loading is not necessary. Toxecon used in conjunction with sorbent injection would be a viable control option if multi-pollutant control is desired. For plants firing bituminous coal, a switch to a western coal would reduce the HCl loading on the ESP, likely enabling dry sorbent injection alone to achieve the Toxics Rule emission limitation.

3.7.3 Mercury (Hg)

The Hg control strategy under this configuration would depend on the fuel being fired. For plants burning western coals, or those requiring additional PM control or desiring Hg removal upstream of the FGD system, Toxecon with activated carbon injection would likely be the best control strategy. Alternatively, an ACI system using brominated sorbent may be used for plants burning western coals; however, mercury removal under this option depends on ESP performance. Installation of a wet FGD may be a viable option for plants that desire additional SO_2 control; using this strategy, bromide addition may also be an option for mercury control for EGUs firing western fuels.

The primary choice for a plant firing bituminous coal would likely be an ACI with additional SO_3 control technology. However, plants firing bituminous coal will be challenged to achieve desired

mercury reductions due to SO_3 interference. Plants firing lignite containing high mercury levels (e.g., Texas lignite) will require high levels of removal which are difficult to obtain across an ESP. In both cases, a switch to a low-sulfur sub-bituminous coal would lower mercury emissions via better mercury control performance and, for Texas lignite fired EGUs, lower coal mercury levels.

[Page 14]

3.8 ESP-FGDw Configuration

3.8.1 Particulate Matter (PM)

The compliance strategy for PM under this configuration will depend on the performance of existing controls. Assuming the existing ESP does not provide adequate control to meet the Toxics Rule emission limitation, the first option to provide additional control would be an upgrade of the ESP, the scrubber mist eliminator, or both. Alternatively, Toxecon could also be added downstream of the existing ESP if multi-pollutant control is desired.

3.8.2 Hydrochloric Acid (HCl)

Plants equipped with a high-efficiency wet FGD system are unlikely to require additional controls to meet the HCl emission limitation in the Toxics Rule. If additional removal is needed, removal efficiencies could be improved by one or more of the FGD upgrades described in Appendix A or by or a dry sorbent injection system.

3.8.3 Mercury (Hg)

The Hg control strategy under this configuration would depend on the fuel being fired. For plants requiring additional PM control or desiring Hg

removal upstream of the FGD system, Toxecon with activated carbon injection would likely be the best control strategy. Bromine addition would likely be the primary control strategy for plants burning low-sulfur fuels. Alternatively, for plants burning low-sulfur fuel, ACI is another control option. ACI would also be an option for plants firing bituminous coal, but SO_3 control technology may be necessary Under this configuration, scrubber re-emission additives may be required to control Hg emissions in conjunction with other control technology, depending on mercury removal performance of the wet FGD.

3.9 Installation Schedule

None of the typical configurations considered in this assessment included existing mercury controls, though many EGUs are presently equipped with ACI. Accordingly, this analysis concludes that every EGU configuration would require mercury control, and identifies ACI as the technology of choice for six of the seven configurations considered. ACI has a typical installation time of 12 to 18 months after permitting. As URS assumes fabric filters to provide adequate PM control to comply with the Toxics Rule PM emission limitation, ESP upgrades are the top-ranked alternative for improving PM control from EGUs. Depending on the scope of the upgrade, installation times for ESP upgrades typically run from six months for the simpler upgrades to twenty-four months for the most comprehensive upgrades. Dry FGD technology, with a typical installation time of 24 to 36 months, was identified as the top-ranked

[Page 15]
technology for only two of the seven configurations evaluated. Dry FGD has the longest installation time of the top-ranked technologies.

These installation times are not cumulative; rather, plants installing multiple technologies would typically coordinate installation so that all controls for mercury, HCl and PM would be installed during the same outage, although some additional outage time may be necessary to coordinate simultaneous installation. With nearly four years between the proposal of the Toxics Rule and the date EGUs must come into compliance, these improvements can be accomplished on-time, provided EGU owners move quickly to initiate these upgrades in response to the proposed rule, and no unreasonable delays occur in the permitting process or supply chain.[6]

4.0 Conclusion

Using the emission limitations proposed by EPA in the Toxics Rule as its guide, URS examined the existing field of demonstrated, available AQC technologies to determine whether these technologies would be sufficient to allow typical coal-fired and oil-fired EGUs to achieve these emission limitations. URS concluded that the emission limitations proposed in the Toxics Rule can be achieved by typical EGUs through the application of successfully demonstrated, available AQC technologies. The controls considered in this analysis can typically be

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[6] Potential delays associated with heavy equipment lead times have not been included in this analysis because it is not possible to predict at this time whether any particular delay will occur.

installed in 18 months (for ACI), 24 months (for ESP upgrades), or 36 months (for FGDs) after detailed design and permitting is complete. If EGU owners make their technology choices and initiate the permitting process promptly, they should be able to comply with the Toxics Rule emission limits by the deadline of early 2015 (almost 48 months after proposal of the rule). Plants facing extreme delays in permitting or the supply chain, or with atypically complex upgrade requirements, have an opportunity to request an additional year to come into compliance with the Toxics Rule.

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AND
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In the Supreme Court of the United States

MICHIGAN, ET AL., PETITIONERS
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

UTILITY AIR REGULATORY GROUP, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

NATIONAL MINING ASSOCIATION, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

ON WRITS OF CERTIORARI
TO THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

JOINT APPENDIX – VOLUME 3 OF 4

Donald B. Verrilli, Jr.
Solicitor General
Counsel of Record
Department of Justice
Washington, D.C.
20530-0001
SupremeCtBriefs@usdoj.gov
(202) 514-2217

Aaron D. Lindstrom
Solicitor General
Counsel of Record
P.O. Box 30212
Lansing, Michigan 48909
LindstromA@michigan.gov
(517) 373-1124

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Melissa Hoffer
Counsel of Record
Assistant Attorney General
Environmental Protection Division
One Ashburton Place
18th Floor
Boston, MA 02130
melissa.hoffer@state.ma.us
(617) 963-2322

Brendan K. Collins
Counsel of Record
Ballard Spahr LLP
1735 Market Street
51st Floor
Philadelphia, PA 19103
collins@ballardspahr.com
(215) 665-8500

Sean H. Donahue
Counsel of Record
Donahue & Goldberg LLP
1130 Connecticut Ave., NW
Suite 950
Washington, D.C. 20036
sean@donahuegoldberg.com
(202) 277-7085

F. William Brownell
Counsel of Record
Hunton & Williams LLP
2200 Pennsylvania Ave., NW
Washington, D.C. 20037
bbrownell@hunton.com
(202) 955-1500

Peter S. Glaser
Counsel of Record
Troutman Sanders LLP
401 Ninth Street, NW
Suite 1000
Washington, D.C. 20004
Peter.glaser@troutmansanders.com
(202) 274-2998

TABLE OF CONTENTS

VOLUME 1 OF 4

Relevant Docket Entries
White Stallion Energy Center v. *EPA*
Court of Appeals
Docket No. 12-1100 1–26

U.S. EPA, Mercury Study Report to Congress,
Vol. 1: Executive Summary, EPA-452/R-97-003
Docket No. EPA-HQ-OAR-2009-0234-3054
December 1997

Excerpts

Overview [pp. O-1 to O-4] 27–35

Report to Congress [pp. 1-1 to 1-3] 36–43

[pp. 4-1 to 4-10] 44–60

EPA Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress, Volume 1
Docket No. EPA-HQ-OAR-2009-0234-3052
February 1998

Excerpts

Executive Summary
[pp. ES-1 to ES-29] 61–114

Utility Study Section 2.7 [p. 2-25] 115–116

Title I and Title IV,
Phase I and Phase II,
Compliance Strategy Impact
[pp. 2-31 to 2-32] 117–119

6.0 Inhalation Risk Assessment
[pp. 6-1 to 6-7] 120–131

Table 7-1 [pp. 7-8] 132–134

Areas for Further Research and Analysis
[pp. 14-8 to 14-10] 135–138

69 Fed. Reg. 4652
January 30, 2004
[pp. 4657 to 4659] 139–145

70 Fed. Reg. 15994
March 29, 2005
Sections F & G
[pp. 16019 to 16022] 146–162

Coal-to-Gas Conversion TSD,
EPA-HQ-OAR-2009-0234-3065
March 4, 2011 163–166

Memo, "National Emission Standards for Hazardous Air Pollutants (NESHAP) Beyond the Maximum Achievable Control Technology (MACT) Floor Analysis for Coal- and Oil-fired Electric Utility Steam Generating EGUs"
EPA-HQ-OAR-2009-0234-2924
March 14, 2011 167–179

National Mining Association's Comments
Docket No. EPA-HQ-2009-0234 (NESHAP action) and EPA-HQ-OAR-2011-0044 (NSPS)
76 Federal Register 24,976
May 3, 2011
Excerpt
[pp. 26 to 27] 180–185

Connecticut Department of Energy and Environmental Protection comments
EPA-HQ-OAR-2009-0234-20298
July 12, 2011
Excerpts
Cover letter and attachment
[pp. 1 to 2] 186–193

South Carolina Department of Health and Environmental Control comments
EPA-HQ-OAR-2011-0444-5749
July 20, 2011 194–213

Massachusetts Department of Environmental Protection comments
EPA-HQ-OAR-2009-0234-18039
July 29, 2011

Excerpts

[pp. 1 to 4] 214–218

[pp. 6 to 7] 219–227

New England Interstate Water Pollution Control Commission comments
EPA-HQ-OAR-2009-0234-17625
August 2, 2011 228–231

Northeast States for Coordinated Air Use Management comments
EPA-HQ-OAR-2009-0234-17843
August 2, 2011

Excerpts

[pp. 1 to 10] 232–252

Attachment A (table) [pp. A-1 to A-2] ... 253–254

VOLUME 2 OF 4

Michigan Department of Environmental Quality comments, EPA-HQ-0234-2009-0234-18426
August 3, 2011 255–277

National Association of Clean Air Agencies comments, EPA-HQOAR-2009-0234-17620
August 4, 2011

Excerpts

Cover letter and comments [pp. 1 to 10] 278–305

Attachment 1 (table) [pp. 1 to 15] 306–320

New Jersey Department of Environmental Protection, comments EPAHQ-OAR-2009-0234-18444
August 4, 2011

Excerpts

[pp. 1 to 2] 321–323

[pp. 4 to 5] 324–327

[pp. 9 to 10] 328–329

Comments of Environmental and Public Health Groups on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule. Docket No. EPA-HQ-OAR-2011-0044-5715
August 4, 2011

Excerpt

Chapter I [pp. I-1 to I-38] 330–382

Comments of Environmental Defense Fund on the National Emission Standards for Hazardous Air Pollutants From Coal-and Oil-Fired Electric Utility Steam Generating Units, Docket No. EPA-HQ-OAR-2009-0234-18421
August 4, 2011

Excerpt

Part I [pp. 3 to 7] 383–392

EPRI Comments on Proposed HAPs MACT Rule
EPA-HQ-2009-0234-17621
August 4, 2011

Excerpts

Specific Comments on the Environmental Fate and Transport, Exposure and Human Health Issues, and Risk Analyses [p. viii to x] 393–399

EPRI's comprehensive sector-wide inhalation risk assessment on all 470 coal-fired generating facilities identified no cancer or non-cancer health risks above regulatory risk threshold, in contrast to EPA's 16 case studies assessment
[pp. 3-22 to 3-27] 399–411

[pp. 3-46 to 3-48] 412–418

[pp. 3-53 to 3-56] 419–422

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17648, Part 1 of 3
August 4, 2011

Excerpts

Comment 1, Sections 1.1 through 1.2
[pp. 6 to 12] 423–436

Comment 2, Sections 2.1 through 2.3
[pp. 21 to 38] 436–468

Comment 3, entire
[pp. 38 to 53] 468–497

Comment 4, entire
[pp. 54 to 56] 497–503

Comment 5
[pp. 56 to 71] 503–532

Comment 7, Section 7.5
[pp. 88 to 90] 532–536

Comment 7, Section 7.7
[pp. 92 to 94] 536–539

Exhibit 2, MJ Bradley & Associates LLC and Analysis Group, "Ensuring a Clean, Modern, Electric Generating Fleet while Maintaining Electric System Reliability" (Aug. 2010) – Entire report, no attachments [pp. 1 to 24] 540–590

Exhibit 4, NESCAUM Report, "Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants" (Mar. 31, 2011) – Executive Summary
[pp. 1 to 4] 591–600

Exhibit 7, URS Report – Entire report, no appendices
[pp. 1 to 15] 601–624

VOLUME 3 OF 4

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule
Docket No. EPA-HQ-OAR-2009-0234-17651
Part 2 of 3
August 4, 2011

Excerpts

Exhibit 10, MJ Bradley Report Update – Entire report [pp. 1 to 20] 625–665

Exhibit 11, Tierney and Cicchetti Peer Review of EEI Report – Entire report [pp. 1 to 13] 666–685

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17650, Part 3 of 3
August 4, 2011

Excerpts

Exhibit 21 – Cicchetti Report – Entire report [pp. 1 to 50] 686–754

Exhibit 23 – Environmental Health & Engineering Inc. Report – Executive Summary and Sections 1.0 to 3.3 [pp. 1 to 22] 755–796

VOLUME 4 OF 4

New York Department of Environmental Conservation comments,
EPA-HQ-OAR-2009-0234-17796
August 4, 2011

Excerpts

Cover letter 797–801

Enclosure A [pp. 1 to 2] 802–806

==========

Comments of the Utility Air Regulartory Group
August 4, 2011

Excerpts

Attachment 15 [pp. 6, 12, 15, 16] 807–810

==========

Letter from Dr. Deborah Swackhamer and Dr. Stephen Roberts, Science Advisory Board to Lisa Jackson, Administrator, U.S. EPA,
EPA-OAR-2009-0234-18487 – Text only
Sept. 29, 2011 811–814

==========

Supplement to the Non-Hg Case Study Chronic Inhalation Risk Assessment In Support of the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units
EPA-HQ-OAR-2009-0234-19912
November 2011

Excerpts

3. Chronic Inhalation Risk Assessment [p. 10 to 12]..... 815–817

3. Results [p. 12]..... 818

Table 9 [p. 13]..... 819–820

Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard, EPA-454/R-11-014
November 2011

Excerpts

All title pages and text pages [pp. 1 to 3]..... 821–829

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 1 of 2
December 2011

Excerpts

Response to comment 25 [p. 13]..... 830

2. Consideration of both public health and environmental effects [pp. 23 to 29] 831–847

a. Agreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [p. 39] 847

b. Disagreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [pp. 39 to 41] 847–853

c. Agreement that EGUs were properly listed under CAA section 112(c)(1) and may not be delisted because they do not meet the delisting criteria in CAA section 112(c)(9). [pp. 52 to 54] 853–858

9. Consideration of criteria pollutants under Appropriate and Necessary Finding [pp. 55 to 59] 858–867

Response to comments 1 – 3 [p. 77] 867–869

Comment 9 and Response [pp. 79 to 81] 869–874

Response to Comment 30 [pp. 435] 874–875

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 2 of 2
December 2011

Excerpts

Response to Comments 49-50
[p. 322] 876–877

Response to Comments 52-62
[pp. 328-331] 878–884

Impacts and Costs Analysis, Comment 1 and response [p. 477] 885

Impacts and Costs Analysis, Comment 5 and response [p. 478] 885–886

Impacts and Costs Analysis, Comment 10 and response [pp. 482 to 484] 886–890

Impacts and Costs Analysis, Comments 6 to 10 and responses [pp. 627 to 630] 890–899

Impacts and Costs Analysis, Comment 11 and response [pp. 630 to 631] 899–902

Impacts and Costs Analysis, Comment 12 and response [pp. 631 to 632] 902–903

Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards
EPA-HQ-OAR-2009-0234-20131
December 2011

Excerpts

Executive Summary, ES.1
[p. ES-1, Table ES-1] 904–907

Executive Summary, ES.1.1, Health Co-Benefits
[pp. ES-3 to ES-4] 908–911

Executive Summary, ES.1.2, Welfare Co-Benefits
[pp. ES-4 to ES-5] 911–912

Executive Summary, ES.2, Tables ES-5, ES-6, Not All Benefits Quantified
[pp. ES-9 to ES-13] 913–923

[pp. 3-10] 924–925

[pp. 3-33] 926–927

[pp. 5-15] 928–929

Chapter 4, Section 4.2 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Human Health) [pp. 4-3 to 4-5] 930–933

Chapter 4, Section 4.3 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Ecosystems and Wildlife) [pp. 4-6 to 4-9] 934–940

Chapter 4, Section 4.8.5.6 (Mercury and Other HAP Benefits Analysis/Unquantified Benefits)
[pp. 4-64 to 4-66] 940–944

Chapter 4, Section 4.9 (Mercury and Other HAP Benefits Analysis/Benefits Associated with Reductions in Other HAP than Mercury) [pp. 4-68 to 4-73] 944–953

Chapter 5, Synopsis (Health and Welfare Co-Benefits) [p. 5-1] 954–955

Chapter 5, Section 5.5 (Health and Welfare Co-Benefits/Unquantified Health and Welfare Benefits) [p. 5-59] 956

==========

Memorandum, "The Environmental Protection Agency's Enforcement Response Policy for Use of Clean Air Act Section 113(a) Administrative Orders in Relation to Electric Reliability And The Mercury and Air Toxics Standard" (
December 16, 2011 957–970

==========

Memo, "Emission Reduction Costs for Beyond-the-floor Mercury Rate for Existing Units Designed to Burn Low Rank Virgin Coal"
EPA-HQ-OAR-2009-0234-20130
December 16, 2011 971–976

==========

Emission Reduction Costs for the Beyond-the-Floor Mercury Rate in the Toxics Rule
EPA-HQ-OAR-2009-0234-2925
Undated 977–981

The following opinions and order have been omitted in printing this Joint Appendix because they appear on the following pages in the appendix to the Petition for a Writ of Certiorari:

14-46 Michigan, et al. v. EPA, et al.

Federal Register
Volume 70, No. 59
March 29, 2005
Pages 16,000–01 ..... 116a–120a

Federal Register
Volume 76, No. 85
May 3, 2011
Pages 24,987–88 ..... 112a–115a

Federal Register
Volume 77, No. 32
February 16, 2012
Page 9,327 ..... 109a–111a

United States Court of Appeals
for the District of Columbia Circuit
Opinion in 12-1100
issued April 15, 2014 ..... 1a–105a

14-47 UARG v. EPA, et al.

APPENDIX J: U.S. Environmental Protection Agency, EPA-453/R-98-004a, Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units -- Final Report to Congress, Vol. 1 (Feb. 1998), Docket No. EPA-HQ-OAR-2009-0234-3052 (excerpts) 636a

APPENDIX I: U.S. Environmental Protection Agency, Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units; Notice of Regulatory Finding, 65 Fed. Reg. 79,825 (Dec. 20, 2000) 610a

APPENDIX H: U.S. Environmental Protection Agency, Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List; Final Rule, 70 Fed. Reg. 15,994 (Mar. 29, 2005)(excerpt)..... 544a

APPENDIX F: Utility Air Regulatory Group, Comments on National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units: Proposed Rule (Aug. 4, 2011), Docket No. EPA-HQ-OAR-2009-0234-17775 (excerpts)..... 510a

APPENDIX G: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Proposed Rule, 76 Fed. Reg. 24,976 (May 3, 2011) (excerpts) 514a

APPENDIX E: EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units, Vol. 1 (Dec. 2011), Docket No. EPA-HQ-OAR-2009-0234-20126 (excerpts)..... 506a

APPENDIX C: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final Rule, 77 Fed. Reg. 9304 (Feb. 16, 2012) (excerpts) 105a

APPENDIX B: Opinion of the U.S. Court of Appeals for the District of Columbia Circuit.. 3a

APPENDIX A: Order of the U.S. Court of Appeals for the District of Columbia Circuit Denying All Petitions for Review, Except the Petition for Review in No. 12-1174, and Dismissing That Petition 1a

14-49 NMA v. EPA, et al.

APPENDIX F: Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units (excerpts).....1937a

APPENDIX E: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, Proposed Rule 76 Fed. Reg. 24,976 (May 3, 2011).....1161a

APPENDIX D: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional SteamGenerating Units, 77 Fed. Reg. 9,305 (Feb. 16 2012) 196a

APPENDIX C: 42 U.S.C.S. § 7412.....101a

APPENDIX B: In the United States Court of Appeals for the District of Columbia Circuit – Judgment (Apr. 15, 2014) 99a

APPENDIX A: In the United States Court of Appeals for the District of Columbia Circuit – Opinion (Apr. 15, 2014) 1a

625

Part 2 of 3

COMMENTS OF EXELON CORPORATION ON U.S. ENVIRONMENTAL PROTECTION AGENCY'S PROPOSED NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FROM COAL- AND OILFIRED ELECTRIC UTILITY STEAM GENERATING UNITS AND STANDARDS OF PERFORMANCE FOR FOSSIL-FUEL-FIRED ELECTRIC UTILITY, INDUSTRIALCOMMERCIAL-INSTITUTIONAL, AND SMALL INDUSTRIALCOMMERCIAL- INSTITUTIONAL STEAM GENERATING UNITS

Docket ID No. EPA-HQ-OAR-2009-0234 and
Docket ID No. EPA-HQ-OAR-2011-0044
76 Fed. Reg. 24,976 (May 3, 2011)

Exhibits 10 - 20

August 4, 2011

* * *

EXHIBIT 10

To Comments Of Exelon Corporation On Docket ID No. EPA-HQ-OAR-2009-0234 and Docket ID No.EPA-HQ-OAR-2011-0044 76 Fed. Reg. 24,976 (May 3, 2011)

M.J. Bradley & Associates LLC & Analysis Group, "Ensuring a Clean, Modern Electric Generating Fleet while Maintaining Electric System Reliability: Summer 2011 Update," (June 2011) ("M.J. Bradley Update")

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[Page 3]
Executive Summary

In August 2010, M.J Bradley & Associates and Susan Tierney of the Analysis Group were commissioned to prepare a study on the impact of two major U.S. Environmental Protection Agency ("EPA") air regulations affecting the electric power sector: (1) the Clean Air Transport Rule ("Transport Rule") and (2) the national emission standards for hazardous air pollutants from coaland oilfired electric utility steam generating units ("Utility Toxics Rule"). The study concluded that the electric industry is wellpositioned to comply with EPA's proposed air regulations without threatening electric system reliability.

This "Summer 2011 Update" supplements the original analysis in light of new information and

reaffirms the major conclusion of the prior report that the electric industry can comply with EPA's air pollution rules without threatening electric system reliability provided that EPA, the industry and other agencies take practical steps to plan for the implementation of these rules and adopt appropriate regulatory approaches. Proper planning and implementation can secure important public health benefits, reliable electric service, and efficient market outcomes.

Since our analysis was released in August 2010, EPA has published its proposed Utility Toxics Rule and should be close to issuing the final Transport Rule.

1. **EPA has proposed achievable standards for coalfired power plants for mercury, acid gases, and other hazardous air pollutants. The proposed emission limits are well within the capability of existing pollution control technology, and allow options for costeffective compliance strategies.**

- The Utility Toxics Rule proposes emissions standards for existing coalfired power plants for mercury, particulate matter ("PM"), and hydrochloric acid ("HCl"). Companies can choose any combination of control systems or operational changes that enable them to achieve the proposed limits.

- Nearly 60 percent of all coalfired boilers that submitted stack test data to EPA are currently achieving the Utility Toxics Rule's proposed

mercury emissions standard.[1] This translates to more than 100 boilers (out of a total of 178). These power plants are meeting the proposed standard with a wide variety of pollution control systems and configurations (e.g., wet scrubbers, dry scrubbers, baghouses, and carbon injection systems).

- Many states already impose more stringent mercury emissions limits on coalfired power plants than have been proposed by EPA; these states, where plants are already in compliance with those stricter standards, include Illinois, Massachusetts, New Jersey, Connecticut, Delaware, and New York.

- About 70 percent of all coalfired boilers that submitted stack test data to EPA are currently achieving the proposed standards for PM and HCl. Close to 160 coalfired generating units report emissions below the level of the proposed HCl standard (out of 217), and close to 120 units report emissions below the proposed PM standard (out of 172). All of the proposed standards (mercury, PM, and HCl) allow companies to average their emissions across multiple boilers at a single facility. Smaller boilers, which may only operate a limited number of hours each year, may comply without any major capital upgrades if colocated with a bettercontrolled boiler. Almost 20 percent of existing coal capacity that currently

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[1] Based on EPA's revised standard of 1.2 pounds per trillion British thermal units (lb/TBtu).

lacks "scrubbers" is colocated at plants with existing scrubbers. These units can potentially

[Page 4]
benefit from the averaging provisions of the rule, reducing the costs and potential retirements from the Utility Toxics Rule, as well as avoiding any related reliability issues.

- EPA has proposed a "work practice standard" to control emissions of dioxins and furans, rather than setting a numeric emissions limit. The work practice standard requires "good combustion practices" to limit the formation of organic HAPs.

- Several studies, published before EPA issued its Utility Toxics Rule, have projected widespread coal plant retirements in the U.S. The higher end projections are likely overstating future levels of retirements given what we now know about EPA's proposed approach and the market response to date.

2. Recent corporate financial statements and other recent announcements confirm that at least some of the nation's largest coalfired generating companies are well positioned to comply with EPA's proposed air quality rules.

- Benjamin G.S. Fowke, III, President and Chief Operating Officer of Xcel Energy, said: "Like many of our peers, we are in the process of evaluating what if any impact [EPA's Utility Toxics Rule] may have on our operations. Based on our preliminary review we do not anticipate that the rule will require extensive changes to our

plans at [Northern States Power] and [Public Service Company of Colorado]...Our proactive steps to reduce emissions through the MERP project in Minnesota and our plans for the Clean AirClean Jobs Act in Colorado put us in good position to comply with these rules." *April 28, 2011, Xcel Energy Inc. 1st Quarter 2011 Earnings Call*

- Jim Rogers, President and CEO of Duke Energy, said: "[T]he anticipation of more stringent environmental rules has long been part of our business plan. Over the past 10 years, we have spent $5 billion retrofitting existing units with updated emissions controls...Today, approximately 75% of our current coal generation capacity has scrubbers in operation. This will increase to approximately 90%, once our fleet modernization program and related retirements are completed...We have really mitigated a lot of the risk and the cost associated with this program by the early steps that we took." *May 3, 2011, Duke Energy 1st Quarter 2011 Earnings Call*

- According to Gale Klappa, Chairman, President and CEO of Wisconsin Energy: "We really see very little impact on customer electric rates or our capital plan between now and 2015 as a result of all the new EPA regulations that have been proposed...We might see 1% to 2% increase our best guess [sic]. So that gives you an example of how well we are positioned from the environmental standpoint in terms of complying with even the new proposed rule." *May 3, 2011,*

Wisconsin Energy Corporation 1st Quarter 2011 Earnings Call

- Reacting to EPA's proposed Utility Toxics Rule, Theodore Craver, chairman, president and CEO of Edison International said: "We installed the necessary equipment back in 2009 and are already achieving these [mercury] limits. U.S. EPA's rule contained other draft provisions covering acid gases and nonmercury metals, which we can meet by installing the pollution control equipment we have been planning to use at Midwest Gen to meet our SO_2 emissions commitments to the Illinois EPA." *May 2, 2011, Edison International 1st Quarter 2011 Earnings Call*

- William Spence, Chief Operating Officer, Executive Vice President and President of PPL Generation, said: "Our proactive approach to environmental compliance positions the PPL fleet favorably for future EPA regulation. Ninetysix percent of the competitive coal generation is scrubbed, 88 percent has NO_x controls already installed." *February 4, 2011, PPL 4th Quarter 2010 Earnings Call*

[Page 5]

- Mauricio Gutierrez, Executive Vice President and Chief Operating Officer of NRG reports that: "The proposed [Utility Toxics Rule] provides flexibility in that compliance can be achieved through facility averaging and company selected control technology. It also recognizes the inherent differences in mercury emissions from lignite coal...[t]he key takeaway is that we do not expect

at this time any additional environmental CapEx beyond what we have previously announced." *May 5, 2011, NRG Energy 1st Quarter 2011 Earnings Call*

- The Tennessee Valley Authority ("TVA"), which owns 17,000 megawatts ("MW") of coalfired generating capacity, announced plans in April 2011 to retire 18 older coalfired generation units at three power plants (2,700 MW) as part of the utility's vision of being one of the nation's leading providers of lowcost and cleaner energy by 2020. The utility will replace "older and lesseconomical generation with cleaner sources." Tom Kilgore, TVA's President and CEO, said that a "variety of electricity sources, rather than heavy reliance on any single source, reduces longterm risks and helps keep costs steady and predictable....In the longer term, these actions reinforce our vision to keep bills low, keep our service reliability high and further improve air quality as we modernize the TVA power system." *TVA Press Release, April 14, 2011.*

3. The results of PJM's most recent Reliability Pricing Model ("RPM") forward capacity auction clearly indicate the industry can meet future electricity demand while maintaining electric system reliability in one of the most coal-dependent regions of the country.

- On May 13, 2011, PJM announced the results of its RPM forward capacity auction for the period from May 31, 2014 through June 1, 2015. Both the Transport Rule and the Utility Toxics Rule will be in effect by the beginning of 2015. These

results provide uptodate information about how the region's reliability organization will ensure sufficient capacity to meet peak demand conditions after the proposed EPA air regulations go into effect.

- PJM operates the nation's largest integrated power market, serving 54 million customers in 13 midAtlantic and Midwestern states, including all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia.

- To ensure future electric system reliability, PJM's forward capacity auction requires power plant operators and other participating companies to offer (i.e., commit) resources, including both generating capacity and demandside resources, three years in advance of when they are needed.[2]

- The results of the most recent auction confirm that the 13state PJM region will have ample electricity supply after EPA's Transport and Utility Toxics Rules take effect. The market response represents a 20.6 percent reserve margin for the region. The energy resources selected to serve the region included new generating resources, capacity upgrades to existing power plants, new demand response

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[2] There are exceptions to this requirement (e.g., when a company relies on its own generating resources to satisfy its load requirements). See *infra* n.21.

resources, and new commitments to energy efficiency.

- The resources that bid into but fail to "clear the auction" (i.e., to be selected as the lowestcost capacity resources) are not needed for reliability purposes. Generating units that did not clear have the option to retire. In the most recent auction, existing fossil generating units that failed to clear were offset by new generating resources, energy efficiency, and demand response that offered their capacity at lower prices.

- Numerous analyst reports have attempted to predict future levels of coal plant retirements with estimates ranging from 10 to 70 GW. The PJM forward capacity auction is where the "rubber-meets

[Page 6]

the-road," reflecting actual market investment behavior, signaling that sufficient power will be available after EPA's air rules take effect.

4. EPA has the statutory authority under the Clean Air Act to grant, on a casebycase basis, extensions of time to complete the installation of pollution control systems.

- EPA emphasizes in its proposed Utility Toxics Rule that it has the discretion to grant, on a casebycase basis, extensions of time to complete the installation of pollution control systems where appropriate.

- This provision provides companies with the flexibility to schedule the installation of controls across multiple outage periods—maintaining electric system reliability while facilitating the expeditious installation of modern pollution control systems.

- Permitting authorities have used this provision in the past under previous MACT rules.

- If four years is still not enough time to install the necessary controls, EPA and the Department of Energy have the authority to enter into administrative orders of consent or consent decrees with power plants, allowing them to run under specific and limited circumstances to maintain reliability. This approach ensures that reliability standards are maintained without an acrosstheboard delay in the implementation of the rules.

[Page 7]

I. EPA's Proposed Utility Toxics Rule

A. EPA has proposed achievable standards for coalfired generating units for mercury, acid gases, and other hazardous air pollutants

In December, 2000, the U.S. Environmental Protection Agency ("EPA") issued a formal notice concluding that it was "appropriate and necessary" to regulate hazardous air pollutants ("HAPs") from the electric power sector under Section 112 of the Clean Air Act. The finding specifically referenced concerns associated with mercury, arsenic, chromium, nickel, cadmium, dioxin, hydrogen chloride, and hydrogen

fluoride. Almost 11 years later, EPA has issued its proposed rule.[3]

The proposed standards for existing coal-fired generating units are summarized in Table 1 below.

Table 1 – Proposed Standards for Existing Coal-Fired Generating Units

HAP or HAP Surrogate	Proposed Standard
Particulate matter	0.030 lb/MMBtu
Hydrogen chloride	0.0020 lb/MMBtu
Mercury (units designed for coal ≥ 8,300 Btu/lb)	1.2 lb/TBtu[4]
Mercury (units designed for coal < 8,300 Btu/lb)	4.0 lb/TBtu

Note: The Utility Toxics Rule also proposes "output-based" emissions standards for coal-fired generating units (i.e., standards expressed in pounds per megawatthour "MWh"). Companies can demonstrate compliance based on either the "input-based"

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[3] U.S. Environmental Protection Agency ("EPA"), *National Emission Standards for Hazardous Air Pollutants From Coal and OilFired Electric Utility Steam Generating Units and Standards of Performance for FossilFuelFired Electric Utility, IndustrialCommercialInstitutional, and Small IndustrialCommercialInstitutional Steam Generating Units*, Federal Register / Vol. 76, No. 85 / Tuesday, May 3, 2011.

[4] EPA's proposed mercury emissions standard for existing electric generating units designed for coal ≥ 8,300 Btu/lb was revised on May 18, 2011. The standard was adjusted from 1.0 lb/TBtu to 1.2 lb/TBtu.

standards listed above (in million Btu "MMBtu" of heat input) or the output-based limits.

Coalfired generating units emit over 100 chemicals on EPA's list of HAPs—pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive problems or birth defects, and that adversely affect the environment.[5] Rather than requiring companies to comply with standards for each individual HAP emitted from coalfired generating units, however, EPA has proposed the use of "surrogates," simplifying the monitoring and compliance requirements of the rule. For example, particulate matter ("PM") has been proposed as a surrogate for all nonmercury metal HAPs, including arsenic, cadmium, chromium, and lead. Hydrogen chloride ("HCl") is being used as a surrogate for all acid gas HAPs. No surrogate was used for mercury.

EPA's proposed standards were calculated based on an extensive data collection effort, involving hundreds of stack tests at coalfired generating units throughout the country. The Clean Air Act requires that EPA's standards reflect the performance of the "best performing" facilities within the category or subcategory.

Figure 1 compares the proposed standard for mercury[6] with the stack test results from 178 coal

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[5] EPA, *Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units —Final Report to Congress*, EPA–453/R–98–004a, February 1998.

[6] Only about 30 coalfired generating units in the U.S. would be subject to the mercury standard for units designed for coal with

units that conducted stack emissions testing in 2010 as part of EPA's Information Collection Requests ("ICR") emissions testing program. The results show that nearly 60 percent of all coalfired generating units that submitted stack test data to EPA are currently achieving the proposed mercury emissions standard. This translates to more than 100 units (out of a total of 178).

[Page 8]
Figure 1 also shows that the power plants meeting the proposed standard have a wide variety of pollution control systems and configurations that are reducing their mercury emissions. Many of the units that are below the level of the standard have been retrofit with a scrubber (wet or dry) or activated carbon injection ("ACI"). Virtually all of the units with a "baghouse" or fabric filter ("FF") report emissions well below the level of the proposed mercury standard. In many cases, these mercury reductions are being achieved as a cobenefit of existing state and federal pollution control programs aimed at reducing SO_2 and other air pollutants. In some cases, states have adopted mercury control requirements because of the slow pace of the federal rulemaking process. Appendix A provides details on the existing state mercury control requirements. Several states already impose more stringent mercury emissions limits on coalfired power plants than what has been proposed by EPA, including: Illinois, Massachusetts, New Jersey, Connecticut, Delaware, and New York.

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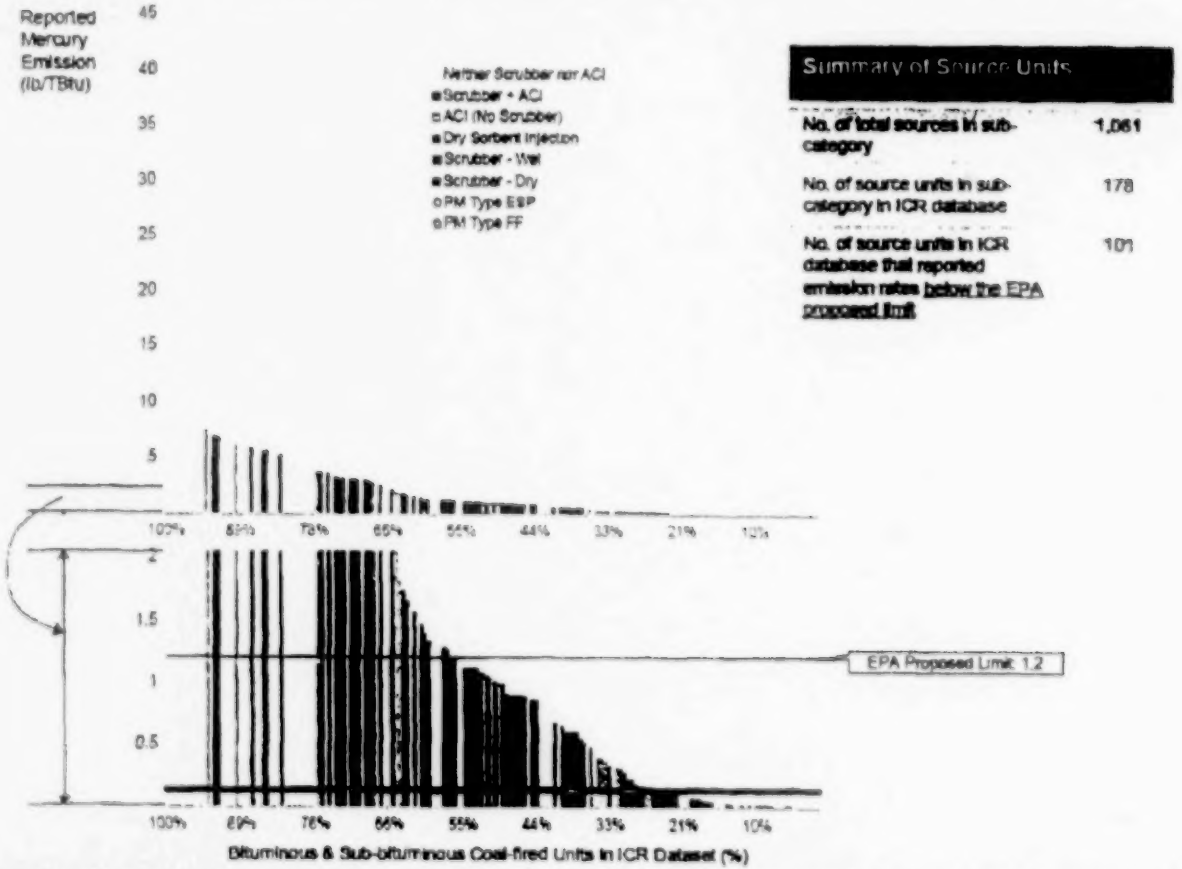
a heat content of less than 8,300 British thermal units per pound (Btu/lb); therefore, we focus our analysis on the mercury standard for units designed for coal ≥ 8,300 Btu/lb.

[Page 8 cont.]

Figure 1 – Proposed Mercury Emissions Standard and ICR Stack Test Results



Note: In order to better reflect the detail of the graph, the lower portion of the figure highlights a narrow band of the upper bar graph (i.e., the area below 2 lb/Tbtu).

[Page 8 cont.]

Figure 2 compares the proposed standard for PM with the stack test results from 172 coalfired generating units that conducted stack emissions testing in 2010. The results show that nearly 70 percent of all coalfired generating units that submitted stack test data are currently achieving the proposed PM emissions standard. This translates to more than 119 units (out of a total of 172).

Figure 3 compares the proposed standard for HCl with the stack test results from 217 coalfired generating units that conducted stack emissions testing in 2010. The results show that 73 percent of all coalfired generating units that submitted stack test data are currently achieving the proposed HCl emissions standard. This translates to 158 units (out of a total of 217).

[Page 9]

Figure 2 – Proposed PM Emissions Standard and ICR Stack Test Results

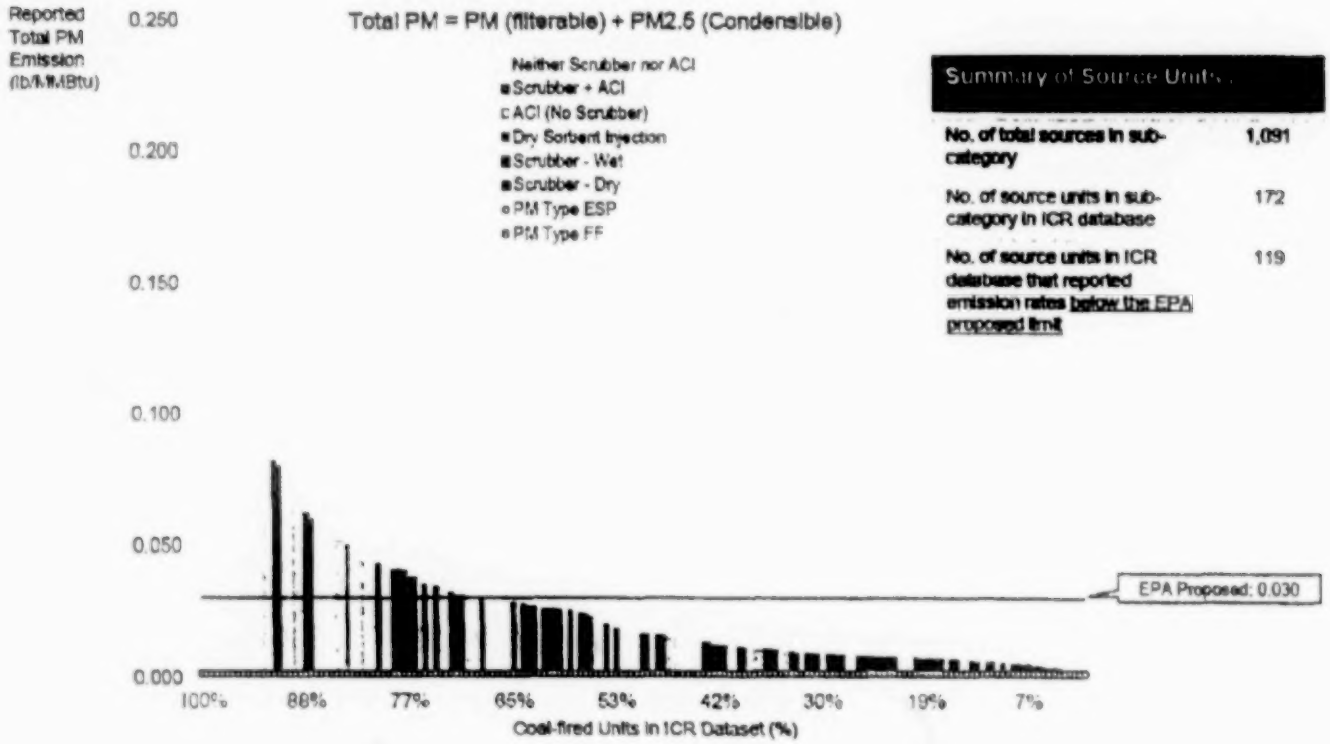


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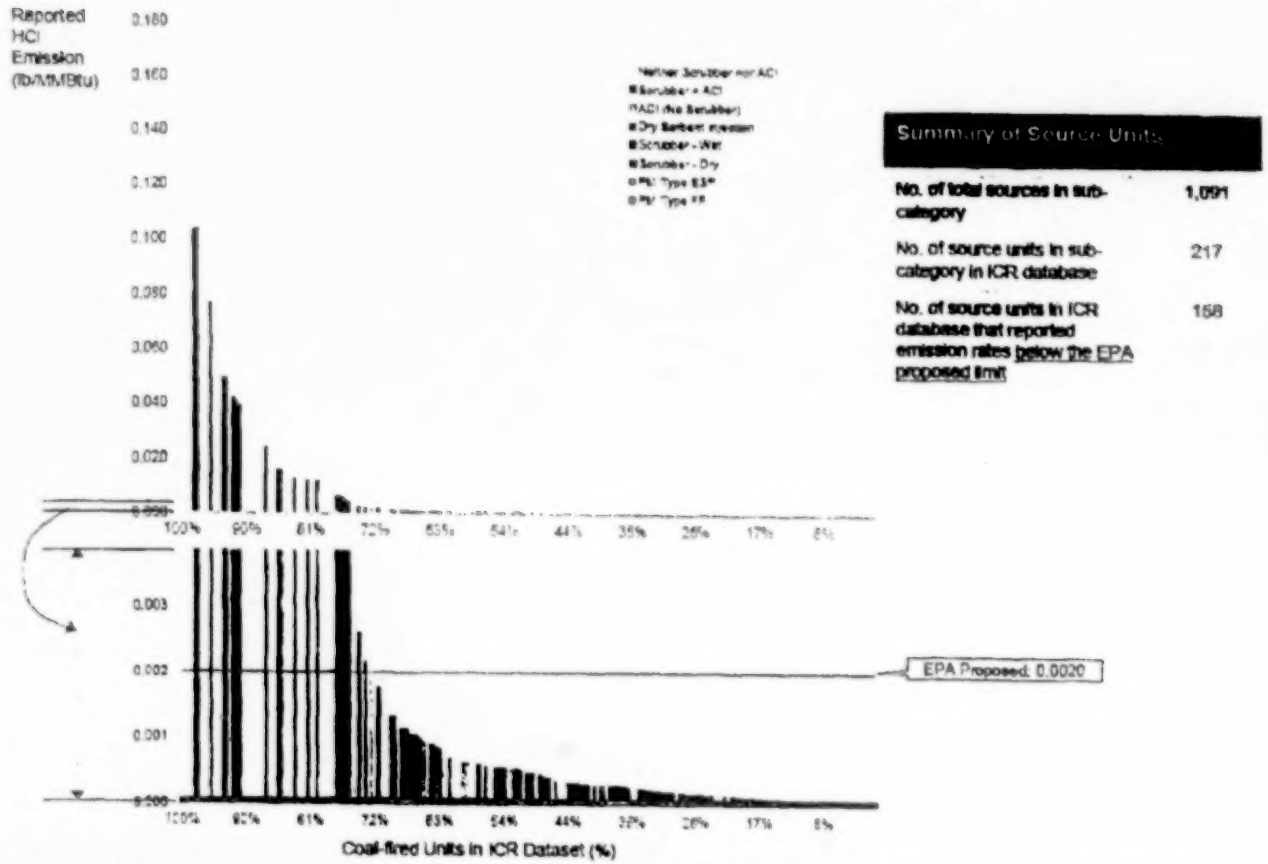
Figure 3 – Proposed HCl Emissions Standard and ICR Stack Test Results



Note: In order to better reflect the detail of the graph, the lower portion of the figure highlights a narrow band of the upper bar graph (i.e., the area below 0.004 lb/MMBtu).

B. The averaging provisions of the Utility Toxics Rule, and work practice standards for dioxins and furans, reduce the costs and potential retirements from the rule

Most coalfired power plants have multiple boilers and electric generating units at a single plant location. The Utility Toxics Rule would allow companies to demonstrate compliance by averaging their emissions across multiple units at an affected source. This flexible compliance option is particularly helpful to smaller generating units that are colocated with larger generating units, but may not be economic to retrofit with pollution control systems.

Smaller boilers, which may only operate a limited number of hours each year, may comply without any major capital upgrades if colocated with a bettercontrolled boiler. Almost 20 percent of existing coal capacity that currently lacks "scrubbers" is colocated at plants with existing scrubbers. These units can potentially benefit from the averaging provisions of the rule, reducing the costs and potential retirements from the Utility Toxics Rule, as well as avoiding any related reliability issues.

EPA has proposed a "work practice standard" to control emissions of dioxins and furans, rather than setting a numeric emissions limit. The work practice standard requires "good combustion practices" to limit the formation of organic HAPs. Companies would perform an annual performance test to ensure efficient fuel combustion.

C. The majority of U.S. coal plants have already installed air pollution controls

As highlighted in our August 2010 report, many coal plants have already installed pollution control technologies to dramatically reduce their air pollution emissions, including NO_x, SO_2, mercury, and other HAPs.

- About 60 percent of the U.S. coal fleet (192 GW) has scrubbers installed or under construction. Scrubbers capture sulfur dioxide ("SO_2"), mercury, HCl, and PM emissions.[7] Among large coalfired generating units—units greater than 400 megawatts ("MW")—more than 70 percent have scrubbers installed. Scrubbers are the most capital intensive technology that a company would potentially need to install to comply with the Utility Toxics Rule.

- About 35 percent of the U.S. coal fleet (112 GW) has fabric filters installed. Fabric filters (or baghouses) can dramatically reduce PM and mercury emissions.[8]

- About 50 percent of the U.S. coal fleet (158 GW) has advanced postcombustion NO_x controls

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[7] Northeast States for Coordinated Air Use Management ("NESCAUM"), *Control Technologies to Reduce Conventional and Hazardous Air Pollutants from CoalFired Power Plants*, March 31, 2011.

[8] *Id.*

installed—selective catalytic reduction ("SCR") or selective noncatalytic reduction ("SNCR").[9]

- More than 70 percent of the U.S. coal fleet has electrostatic precipitators ("ESPs") installed for PM control, although many are older systems designed for lower levels of performance.[10] Companies may need to upgrade their ESPs or replace them with baghouses to comply with the PM limits proposed in the Utility Toxics Rule.

Additionally, new technologies are available that companies will be using to comply with EPA's new air rules. In particular, dry sorbent injection ("DSI") has emerged as a lowcapitalcost alternative to installing a scrubber. DSI can be used to control SO_2 and other acid gases through the injection of a chemical reagent, including sodium bicarbonate, hydrated lime, and a natural occurring mixture of sodium carbonate and

[Page 11]
sodium bicarbonate called *Trona*. Relative to a scrubber, DSI not only has low capital costs but can also generally be installed within 12 months. DSI costs have been estimated at $55 per kilowatt ("kW").[11] Midwest Generation estimates that it can retrofit its entire coal fleet with DSI and fabric filters within 12 to 24 months (of decision) at a cost of

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[9] *Id.*

[10] *Id.*

[11] EPA, *Documentation Supplement for EPA Base Case v4.10_PToxUpdates for Proposed Toxics Rule*, March 2011.

$232/kW.[12] By contrast, a scrubber alone can cost over $400/kW.[13]

Generally, DSI will be considered for coal units burning low sulfur Powder River Basin ("PRB") coal. Other factors that will drive the deployment of DSI include unit size, percentage reduction of emissions required, plant economics, and site specific characteristics. DSI has been deployed at several coalfired generating units in the U.S., including:

- In 2010, NRG's Dunkirk and Huntley power plants installed DSI systems that simultaneously inject Trona and powderactivated carbon ("PAC"). Performance tests indicate that emissions of SO_2 have been reduced by over 55 percent, mercury levels have been reduced by over 90 percent, and particulate levels have been reduced to less than 0.010 lb/MMBtu. NRG considers these installations sufficient and expects no additional environmental capex requirements to comply with the Utility Toxics and Transport rule.[14]

- Duke Energy installed DSI systems in 2010 at its Gallagher generating station. According to the company, the estimated total cost of the DSI system, installed at Units 2 and 4, was $11.6 million or about $41/kW. The system will reduce SO_2 emissions by 50 percent. Duke Energy

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[12] Bernstein Research, *U.S. Utilities: The EPA's Mercury and Air Toxics Standards Are Tougher Than They Appear*, March 2011.

[13] NESCAUM, *supra* n.7.

[14] NRG Energy, *Q1 2011 Earnings Conference Call*, May 5, 2011.

expects the DSI system to help the company comply with the requirements of the Utility Toxics Rule and Transport Rule.[15]

- GenOn operates a DSI system at its Potomac River Generating Station in Alexandria, Virginia. According to the company, the Potomac River plant has seen up to 80 percent reduction in SO_2 emissions since introducing the tronabased system.[16]

- Midwest Generation is seeking to retrofit its coal fleet (12 coalfired units in the Midwest with total capacity of about 5 GW) with DSI technology and upgrade its particulate control systems at a total estimated cost of $1.2 billion.[17] In November 2010 and February 2011, Midwest Generation obtained construction permits from the Illinois Environmental Protection Agency to install DSI systems at its Waukegan and Powerton generating stations.[18]

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[15] Duke Energy Indiana, Inc., *Petition for issuance of a Clean Coal Technology Certificate of Public Convenience and Necessity ("CPCN") pursuant to Ind. Code § 818.7 for the use of a Dry Sorbent Injection System at its Gallagher Generating Station Units 2 and 4, No. 43873* (Indiana Utility Regulatory Commission, Sep 8, 2010).

[16] GenOn, http://www.genon.com/company/companyenvironmentaltechnology. aspx (accessed June 3, 2010)

[17] Edison International, *Q2 2010 Earnings Call Transcript*, http://www.morningstar.com/earnings/16355020edisoninternationaleixq22010. aspx (accessed June 4, 2011)

[18] Midwest Generation LLC, *Form 10K*, February 2011.

- Conectiv Energy installed a Trona based DSI system at its Edge Moor plant (Units 3 and 4) and operated it from 2009 to mid2010 on bituminous coal. The plant has since been converted to run on natural gas obviating the need for the DSI system. [19]

[Page 12]

II. Company Reactions to EPA Rules

A. Financial statements confirm that at least some of the nation's largest coalfired generating companies are well positioned to comply, reflecting the progress throughout the U.S. coal fleet in adding modern pollution control systems

A survey of recent corporate earnings statements shows that several of the companies that own significant quantities of coalfired generating capacity are well positioned to comply with EPA's proposed air quality rules because of earlier investments in their fleets. The following quotes, from a sampling of electric company executives, highlight several important themes: (1) companies have long anticipated these rules; (2) early investments have positioned these companies well for compliance; and (3) the impact on electricity rates can be managed.

- Benjamin G.S. Fowke, III, President and Chief Operating Officer of Xcel Energy, said: "Like many of our peers, we are in the process of evaluating what if any impact [EPA's Utility Toxics Rule] may have on our operations. Based

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[19] NESCAUM, *supra* n.7.

on our preliminary review we do not anticipate that the rule will require extensive changes to our plans at [Northern States Power] and [Public Service Company of Colorado]...Our proactive steps to reduce emissions through the MERP project in Minnesota and our plans for the Clean AirClean Jobs Act in Colorado put us in good position to comply with these rules." *April 28, 2011, Xcel Energy Inc. 1st Quarter 2011 Earnings Call*

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[Page 13]

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- The Tennessee Valley Authority ("TVA"), which owns 17,000 MW of coalfired generating capacity, announced plans in April 2011 to retire 18 older coalfired generation units at three power plants (2,700 MW) as part of the utility's vision of being one of the nation's leading providers of lowcost and cleaner energy by 2020. The utility will replace "older and lesseconomical generation with cleaner sources." Tom Kilgore, TVA's President and CEO, said that a "variety of electricity sources, rather than heavy reliance on any single source, reduces longterm risks and helps keep costs steady and predictable....In the longer term, these actions reinforce our vision to keep bills low, keep our service reliability high and further improve air quality as we modernize the TVA power system." *TVA Press Release, April 14, 2011*

[Page 14]

III. PJM Forward Capacity Auction

A. Results from PJM's RPM forward capacity auction show that the industry is able to meet future electricity demand while maintaining electric system reliability

Recent market information from one region of the country with a large concentration of coalfired power plants provides uptodate information and insights about how various players in the industry plan to respond to the EPA's future air pollution regulations. Market participants not only include owners of power plants affected by the EPA air pollution regulations, but also owners of other power plants and providers of demandside resources, all of whom are critical to ensure regions have access to diverse, reliable, efficient, and environmentally compliant electric resources.

PJM provides reliability and wholesale power market functions for the nation's largest integrated power market, serving 54 million customers in 13 MidAtlantic and Midwestern states including all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia, and the District of Columbia. In addition to operating a centrally dispatched, competitive wholesale electric power market, PJM coordinates and directs the operation of the transmission grid and plans transmission expansion improvements to maintain grid reliability in the region. Much of the generating capacity in PJM's footprint is at coalfired power plants, some of which are old and relatively inefficient. At the end of 2010, coal units comprised 41 percent of capacity in PJM. [20]

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[20] Monitoring Analytics, *State of the Market Report for PJM*, March 10, 2011.

{Removed photo "Keeping the Lights On at the PJM Control Room"} Source: PJM. PJM 2010 Annual Report.

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To secure adequate capacity to meet future projected power demand, PJM recently conducted its latest round of marketbased bidding through its Reliability Pricing Model ("RPM") forward capacity auction. On May 13, 2011, PJM announced the results of that auction, which covers the period from May 31, 2014 through June 1, 2015 – a time when the Utility Toxics Rule and the Transport Rule will both be in effect. PJM's forward capacity auction requires owners of power plants and other participating companies[21] to offer (i.e., commit) resources including both power plants and demandside resources, three years in

[Page 15]
advance so as to maintain electric system reliability. Resources that "clear" the auction receive capacity payments; those that do not clear receive no compensation for their capacity.

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[21] There are exceptions to this requirement for companies that provide their own generating resources to meet their own loads. Power companies in PJM that do not participate in the capacity auction, like AEP and Duke-Ohio, are required to certify that they have adequate capacity to ensure reliable service. These companies have confirmed that they have sufficient electric capacity to meet their needs through June 1, 2015 – more than five months after the EPA rules are expected to take effect.

The results of the May 13th 2011 auction show that while some coal plants[22] were unable to clear the auction and may choose to retire, the region was still able to secure an ample supply of energy resources to maintain reliability. In fact, the market secured resources sufficient to maintain a 20 percent reserve margin for the region.

Out of a total of nearly 150,000 MW of capacity selected in the recent PJM auction,[23] nearly 4,200 MW of new capacity plans to enter the market by 2014/2015, including the addition of new generation capacity resources, capacity upgrades to existing generation capacity resources, new demand resources, upgrades to existing demand resources, and new energy efficiency resources.

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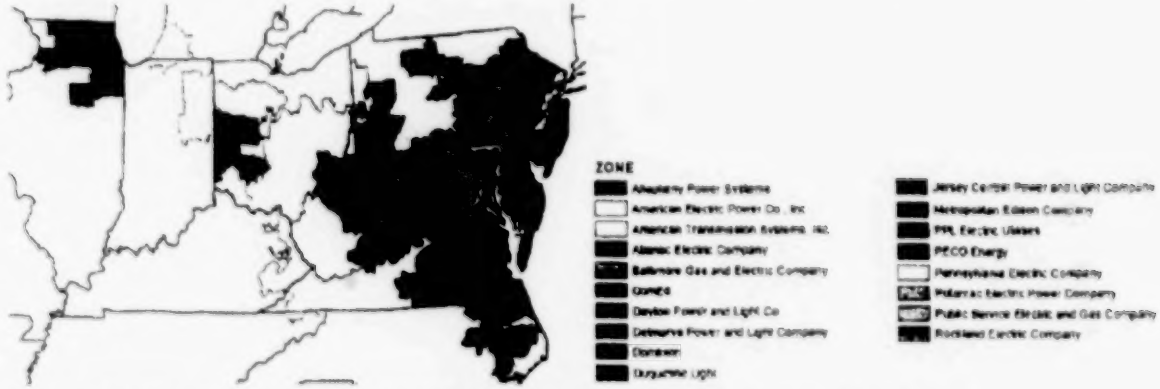
[22] Note that PJM's market monitor had provided guidance to participants in the auction that they should develop their bids assuming compliance with the EPA Utility Toxic Rule: "Question 1: If a participant determines that the costs to meet the proposed MACT rules will be prohibitive, do they need to submit a request for deactivation so that they would not have to offer a unit into the 2014/2015 Base Residual Auction (BRA)? Answer 1: The MMU expects participants to offer units based on their calculated costs of compliance and based on their own economic decisions. If the units do not clear, participants have the option to retire the units." See Monitoring Analytics, *Clarification on ACR Data and Pending EPA Regulations*, April 28, 2011.

[23] This amount is lower than PJM's 2010 generating capacity of 167,362 MW (See PJM, Annual Report, 2010), or its projected capacity requirements for 2014/2015, because some distribution companies are permitted to satisfy their capacity requirements through their own generating resources, as noted previously.

[Page 15]

The PJM Service Territory

"MAAC" is the Mid-Atlantic Area Council Region which is the eastern part of PJM. Within MAAC are the Eastern ("EMAAC") area which includes parts of New Jersey, Eastern Pennsylvania, Delaware and Eastern Maryland – in the areas served by PSE&G, JCP&L, PECO, AE, DPL & RECO); the Southwestern MAAC (parts of Maryland and the District of Columbia, served by PEPCO and BG&E); and the Western MAAC (parts of Pennsylvania served by Penelec, MetEd, PPL). There is also "Western PJM" – in parts of Illinois, Indiana, Ohio, Kentucky and other states (ComEd, AEP, Dayton, APS, Duquesne, ATSI, Duke).



Source: PJM, http://pjm.com/documents/~/media/about-pjm/pjm-zones.ashx (accessed June 3, 2011)

The price of capacity, which accounted for less than 20 percent of PJM wholesale power prices in 2010 when prices were at historic highs, increased and decreased in different parts of the region.[24] As summarized in the chart below, in the Eastern part of PJM (the subregions called "MAAC" and "EMAAC"), prices fell more in line with past price levels. The "RTO" price—representing the price in the portions of the PJM region not constrained by transmission (which effectively is the western portion of the PJM system)—increased to levels that were still below prices in 2010/2011 although slightly above prices in 2009/2010 and 2011/2012.

[Page 16]
The generating units that failed to clear the auction—including fossil generating units that may eventually be slated for retirement—were largely offset by these new generating, energy efficiency, and demand response resources. In its auction results, PJM reported a reduction in committed coal capacity in 2014/2015 equal to 6,900 MW, and suggested that the decrease is likely related to some coal capacity reflecting the costs of environmental retrofits in their offer prices.[25] These costs would make some coal units uneconomic relative to lower cost resources. In contrast to the reduction in committed coal capacity, however, demand response resources increased by 4,836 MW.[26] Commitments to conserve energy

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[24] Monitoring Analytics, *State of the Market Report for PJM*, March 10, 2011.

[25] PJM, *2014/2015 RPM Base Residual Auction Results: Addendum*, PJM DOCS #648604 (May 2011).

[26] *Id.*

through energy efficiency increased by 142.7 MW.[27] The auction also procured 695 MW of wind power and 45.6 MW of solar power.[28]

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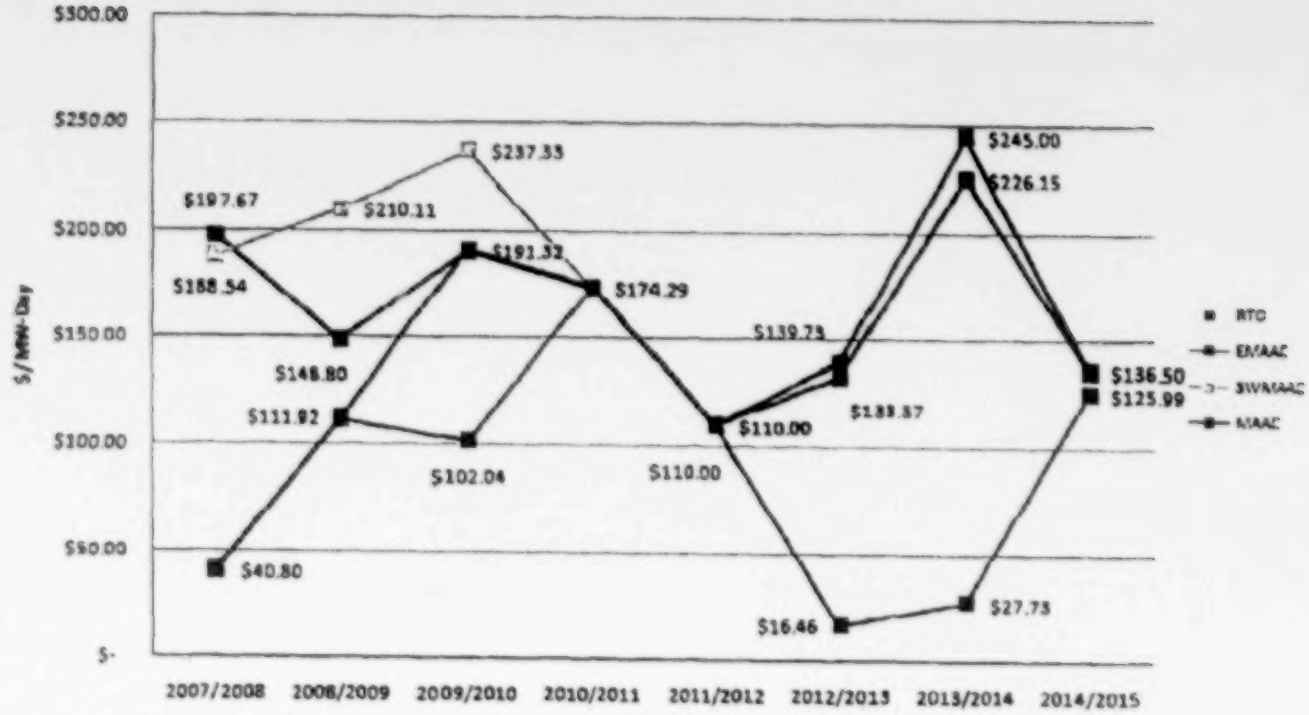
[27] PJM, *2014/2015 RPM Base Residual Auction Planning Period Parameters*, PJM DOCS #631095 (May 2011)

[28] PJM, *Demand Resources and Energy Efficiency Continue to Grow in PJM's RPM Auction*, May 13, 2011.

[Page 16 cont.]

Figure 4 – PJM Base Residual Auction Resource Clearing Prices



Source: PJM, 2014/2015 RPM Base Residual Auction Results, PJM DOCS #645284 (May 2011).
Notes:
RPM – Reliability Pricing Model, with the "Base Residual Auction" being the initial auction each year to select basic resources for a
future period.
"RTO" – Regional Transmission Organization—effectively these are the capacity prices in the western portion of PJM.
"MAAC" – Mid-Atlantic Area Council
"EMAAC" – Eastern Mid-Atlantic Area Council region
"SWMAAC" – Southwest Mid-Atlantic Area Council region

As indicated by the results of PJM's most recent forward capacity auction, the region will have more than enough capacity to meet federal reliability standards set by NERC when the Utility Toxics Rule and the Transport Rule will both be in effect. Notably, more than 5 GW of new capacity came into the market with this auction, including new generation and new demand side resources such as energy efficiency and demand response. This outcome illustrates the diversity of ways that market participants can provide reliable power supplies while meeting future environmental requirements.

B. The results of the PJM forward capacity auction suggest that some projections of future coal plant retirements may be overstated

Numerous analyst reports have been issued since the beginning of 2010, predicting varying levels of coal plant retirements in the U.S. Some of the factors contributing to these retirement projections include lower

[Page 17]
electricity demand, lower natural gas prices, the advanced age of many coalfired generating units, and the increased costs associated with EPA's environmental rules. Many of these reports included impacts from EPA's air regulations as well as other rules (e.g., 316(b) cooling water standards, coal ash rules, and some of the studies have modeled a price on greenhouse gas emissions). Most of these studies were developed prior to the issuance of the Utility Toxics Rule in March 2011. Examples of some of these analyst reports are summarized below, including projected coal capacity retirements.

The results of the recent PJM forward capacity auction, which reflect actual market investment decisions rather than modeled predictions, suggest that the level of coal plant retirements will be more modest than some have predicted and that the 13state PJM region will have ample electricity supply after EPA's air regulations go into effect in the middle of the decade. As EPA's proposed air pollution regulations are more flexible than had been anticipated by some of those studies' "worstcase" scenarios and given the industry can supply needed capacity through a variety of resources, the recent PJM auction results suggest that coal plant retirements will likely fall at the lower range of prior estimates.[29]

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[29] See also S. Tierney and C. Cicchetti, *The Results in Context: A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet," May 2011; and S. Tierney, Electric Reliability under New EPA Power Plant Regulations: A Field Guide,* January 18, 2011, http://www.wri.org/stories/2011/01/electricreliabilityundernewepapowerplantregulationsfieldguide

[Page 17 cont.]

Study by	Release Date	Nationwide Projected Capacity Retirement *(denotes coal capacity only)*	Incremental Retirements *(excludes 18 GW of already announced retirements/idlings)*	Report Title
CERA	March 2011	35 GW (by 2020)	22 GW	*Staying Power Can US Coal Plants Dodge Retirement for Another Decade?* (Private Report)
Bernstein Research	March 2011	54 GW (by 2014/15)	41 GW	*U.S. Utilities: The EPA's Mercury and Air Toxics Standards Are Tougher Than They Appear*
FBR Capital	December 2010	45 GW (by 2018)	32 GW	*Coal Retirements in Perspective: Quantifying the Upcoming EPA Rules*
The Brattle Group	December 2010	40-55 GW (by 2020)	34 GW	*Potential Coal Plant Retirements Under Emerging Environmental Regulations*
NERC	October 2010	15-35 GW (by 2018)	12 GW	*2010 Special Reliability Scenario Assessment: Resource Adequacy Impacts of Potential U.S. Environmental Regulations*
Credit Suisse	September 2010	60 GW (by 2017)	47 GW	*Growth from Subtraction: Impact of EPA Rules on Power Markets*
PIRA Energy Group	April 2010	30-40 GW (by 2015)	22 GW	*EPA's Upcoming MACT: Strict Non- Hg Regs Can Have Far-Reaching Market Impacts*

[Page 18]

IV. EPA Authority to Grant Additional Time for The Installation fo Controls

A. EPA has the statutory authority under the Clean Air Act tc grant, on a casebycase basis, extensions of time to complete the installation of pollution control systems

In general, under the Clean Air Act, Congress requires existing, affected sources to comply with standards for hazardous air pollutants "as expeditiously as practicable, but in no event later than 3 years after the effective date of such standard." As a result, affected coalfired power plants will need to comply with the emissions limits of the Utility Toxics Rule by the beginning of 2015. However, there are exceptions under the law, which allow additional time for the installation of controls, and, in fact, EPA emphasizes in its proposed Utility Toxics Rule that the Agency and state regulatory authorities have the discretion to grant, on a casebycase basis, an additional 12 months for the installation of pollution control systems where appropriate. Permitting authorities have used this provision in the past under previous air toxics rules.

This provision provides companies with the flexibility to schedule the installation of controls across multiple outage periods—maintaining electric system reliability while facilitating the expeditious installation of pollution control systems. Companies will typically construct pollution control systems while a power plant continues to operate. The equipment is then connected or "tiedin" to the plant during a scheduled outage period, coordinated with

other generating facilities to ensure reliability. This will typically occur during a month or month(s) when the demand for electricity is relatively low—avoiding the hottest summer months and the coldest winter months. A 12month extension would provide plant operators with an additional two shoulder periods to schedule outages and stagger the installation of controls.

If four years is still not enough time to install the necessary controls, EPA and the Department of Energy have the authority to enter into administrative orders of consent or consent decrees with power plants, allowing them to run under specific and limited circumstances to maintain reliability. This approach ensures that reliability standards are maintained without an acrosstheboard delay in the implementation of the rules.

V. Conclusion

These new findings support the conclusion that we reached in our August 2010 study on EPA's air regulations and their in plications for electric system reliability. The flexible nature of EPA's regulations, the readiness reported by leaders of many of the companies owning affected coal plants, the recent results of the forward capacity auction in PJM, and the various authorities of EPA and other federal agencies all indicate we can modernize and clean the nation's electric fleet to enhance public health while maintaining electric system reliability.

[Page 20]

APPENDIX A –

State Mercury Regulations

State	Year Enacted	Policy/Rule
New Hampshire	2002	Requires 75% reduction in annual mercury emissions from coal plants compared to 1996/97 emissions.
Connecticut	2003	Requires coal-fired power plants to achieve either an emissions standard of 0.6 lb/tBtu or a 90% efficiency in technology installed to control mercury emissions.
New Jersey	2004	Requires a 90% reduction of mercury emissions from coal-fired power plants by the end of 2007. Plants have the option of meeting the standards in 2012 if they also make major reductions in their emissions of sulfur dioxide, nitrogen oxides, and fine particulates.
Delaware	2006	Requires power plants to capture at least 80% of mercury beginning in 2009 and 90% beginning in 2013.
Maryland	2006	Requires power plants to capture at least 80% of mercury beginning in 2010 and 90% beginning in 2013.
Illinois	2006	Requires power plants to reduce mercury emission by 90% starting in July of 2009.
North Carolina	2006	Requires power plants submit by January 1, 2013 detailed plans and timetables for achieving maximum technically and economically possible mercury reductions at each unit. Units that are not controlled by 2017 must be shut down.
Montana	2006	Requires mercury emitting EGUs to achieve an emission rate lower than 0.9 lb/TBtu by January 1, 2010. EGUs unable to meet this limit after installing an approved control strategy may apply for an alternative limit by July 1, 2011.
Minnesota	2006	Requires MN's largest coal-fired power plants to cut mercury emissions by 90% by 2015.
Massachusetts	2007	Requires power plants to capture at least 85% of mercury (or achieve a rate of 0.0075 lb/GWh) by 2008 and 95% of mercury (or achieve a rate of 0.0025 lb/GWh) by 2012.
New York	2007	Phase I (2010): Power plants must reduce mercury emissions by 50%. Phase II (2015): Implementation of unit-based limits for each facility to reduce mercury emissions by 90% using Maximum Available Control Technologies
Colorado	2007	Requires new or reconstructed units to achieve a minimum mercury capture rate of 90% and implement BACT.
Georgia	2007	*Multi-pollutant Control for EGUs (steam)* requires four specific power plants to carry out feasibility studies for mercury controls by 2018. *Mercury emissions from new EGUs* require the use of BACT to control mercury emissions.

Wisconsin	2008	Requires large (>150 MW) coal-fired power plants to either – a) achieve a 90 percent reduction in mercury emissions from coal by the year 2015; or b) reduce multiple pollutants, including nitrogen oxides (NO_x) and sulfur dioxide (SO_2), and achieve 90 percent reduction in mercury emissions six years later Requires small (> 25 MW and < 150 MW) coal-fired power plants reduce their mercury emissions to BACT level.
South Carolina	2008	Requires power plants to install mercury emission monitoring equipment by June 2009.
Michigan	2009	Requires EGUs to reduce mercury emissions by 90%, or achieve 75% mercury emission reductions along with nitrogen oxides (NO_x) and sulfur dioxide (SO_2) reductions.
Oregon	2010	Caps mercury emissions from new EGUs and requires installation of mercury controls at existing ones. Total statewide mercury emissions limited to 60 lb/year after 2018. New coal plants cannot emit more than 25 lb/year.

Source: Environmental Defense Fund, Mercury Alert: Cleaning up Coal Plants for Healthier Lives, March 2011.

* * *

EXHIBIT 11
To Comments Of Exelon Corporation On Docket ID No. EPA-HQ-OAR-2009-0234 and Docket ID No.EPA-HQ-OAR-2011-0044 76 Fed. Reg. 24,976 (May 3, 2011)

Susan F. Tierney & Charles Cicchetti, "The Results in Context: A Peer Review of EEI's 'Potential Impacts of Environmental Regulation on the U.S. Generation Fleet'" (May 2011) ("Tierney-Cicchetti Peer Review Report")

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[Page 1]

Summary

In January of 2011, the Edison Electric Institute ("EEI") released a report entitled "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet" ("Report") focusing on possible impacts of federal environmental laws and regulations on the electric power industry. Recently, the Report was cited in testimony before the United States House of Representatives Energy and Commerce Committee, and in a variety of other forums, to support the claim that new environmental regulations will trigger as much as 70-80 GWs of coal plant retirements by 2015[1]. This peer review analysis evaluates the

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[1] See Subcommittee on Energy and Power, Committee on Energy and Commerce, United States House of Representatives Hearing, April 15, 2011, Thomas A. Fanning, Chairman, President, and Chief Executive Officer, The Southern Company, Transcript at line 2112, p. 104.

Report's findings in light of the actual proposed Utility Air Toxics and cooling water intake regulations which the Environmental Protection Agency ("EPA") released in March 2011, two months after EEI issued the Report. **We conclude that the Report was based upon worst-case assumptions which have not materialized and upon climate change legislation never enacted into law.**

The Report does not adequately distinguish between the non-environmental drivers of changes in the electricity industry and the various EPA rulemakings. There is also inadequate discussion of the non-traditional alternatives available to meet system requirements, or of various initiatives underway to strengthen the resiliency and reliability of the electricity network. The Report's excessively conservative and often misleading assumptions affect EEI's modeling results.

[Page 2]

There is one reference case and 9 scenario runs in the Report[2]. We reproduce the Report's Table 1[3] and annotate it with information on these assumptions.

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[2] The Report includes a reference case and 9 alternative scenarios that reflect different combinations of assumptions regarding EPA regulations and natural gas prices. The six scenarios that reflect a carbon price are the Report's Scenarios: "2"; "2+Alt CO2"; "2+Alt Air"; "2+Alt Ash"; "2+$1.50 gas"; "2+$3.00 gas."

[3] See EEI, ICF "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet", January 2011, ("Report") Table 3.1, "National Coal Retirements (GW)", p.11.

Table 1 –
Summary of Scenarios
Modeled by EEI with Estimated Coal Plant Retirements:
Reasonable V. Unreasonable Scenarios

GW of Retirements due to market fundamentals, not EPA regulations

GW of Retirements due to EPA regulations

National Coal Retirements (GW)

Run	Scenario	Planned Coal Retirements	Unplanned Coal Retirements		Total Coal Retirements		Incremental Coal Retirements	
		2015	2015	2020	2015	2020	2015	2020
1	Reference Case	6	16	19	22	25	0	0
2	Scenario 1	6	50	50	56	56	34	31
3	Scenario 1 + Alt Air	6	41	41	46	46	24	21
4	Scenario 1 + Alt Water	6	49	50	55	55	33	30
5	Scenario 2	6	73	90	79	95	57	71
6	Scenario 2 + Alt CO2	6	56	73	71	79	50	54
7	Scenario 2 + Alt Air	6	64	77	70	82	48	58
8	Scenario 2 + Alt Ash	6	75	96	81	101	59	76
9	Scenario 2 + $1.50 Gas	6	47	56	52	61	31	37
10	Scenario 2 + $3.00 Gas	6	33	36	38	41	17	17

The shaded rows contain <u>unrealistic</u> assumptions, summarized below:

1. **That Waxman-Markey climate bill is enacted and goes into effect by 2016 with a $26/ton carbon price**
   (all Runs except #1, #2, #3, #4)
2. **That EPA water regulations impose a "one-size-fits all" requirement that all coal plants over a certain size need a cooling tower**
   (all Runs except #1 and #4)
3. **That all coal plants would have to install a scrubber rather than use lower-cost control technologies**
   (all Runs except #1 and #3)

Source of underlying table: Table 1 from the EEI Report, with annotations by authors Tierney & Cicchetti

[Page 2 cont.]

Although not apparent from the labels used for the different scenarios, all of the facility retirement scenarios contain one or more of the following assumptions that were unreasonable at the time that EEI's consultants conducted their study: (1) that the Waxman-Markey climate change bill passed both houses of Congress, *despite the fact that the legislation failed over ten*

[Page 3]

months ago;[4] (2) that EPA would impose a one-size-fits-all cooling tower requirement on U.S. power plants over the course of the next decade, *despite the fact that EPA Administrator Jackson confirmed in an December 16, 2010 letter to Congress that EPA rejected a one-size-fits-all approach (a position that now can be seen in the new regulations proposed in March 2011);*[5] or (3) that industry could not use less costly, alternative technologies and resource options to reduce air toxics emissions *despite the fact that many coal plants already do use these technologies and many utilities now use different options to meet customers' reliability requirements.*

Reliance on so many fundamentally unrealistic assumptions undermines the usefulness of the Report's overall results, since these unreasonable assumptions overstate the impact of environmental

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[4] This assumption is in the Report's Scenarios: "2"; "2+Alt CO2"; "2+Alt Air"; "2+Alt Ash"; "2+$1.50 gas"; "2+$3.00 gas."

[5] Report Scenarios: "1"; "1+Alt Water"; "2"; "2+Alt CO2"; "2+Alt Ash"; "2+$1.50 gas"; "2+$3.00 gas". A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet"

regulations. As such, the results could lead policymakers to an unreasonable and unsupported conclusion that Americans must chose between improving the nation's health and affordable, reliable electricity.

Moreover, contrary to some testimony before the House Energy and Commerce Committee, the Report does not support the proposition that new EPA regulations will drive 70- 80 GWs of retirements by 2015. Only two scenarios – "Scenario 2" (Run 5 in Table 1) and "Scenario 2 + Alt Ash" (Run 8 in Table 1) – showed more than 70 GWs of incremental retirements by 2020, not by 2015. These scenarios contained all three of the erroneous assumptions described above.

We agree with EEI that competitive pressures from natural gas-fired plants fueled by

[Page 4]
relatively inexpensive shale gas are forcing some inefficient, older coal plants out of business.[6] This is shown in the Reference Case, estimating that 22 GW of coal plants will retire by 2015 based on current fuel price and other economic assumptions as well as all policies currently on the books (e.g., state mercury regulation, state-based renewable standards, the Clean Air Interstate Rule).

The most reasonable scenario of the 9 modeled in the Report is the "Scenario 1 + Alt Air" (Run No. 3), which predicts 24 GWs of incremental coal retirements beyond the Reference Case. Market

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[6] These retirements are shown in the Reference Case results.

forces alone will cause approximately one-half of the retirements (22 GW) under this scenario without any new EPA regulations. To put the incremental 24 GWs into perspective, the U.S. currently enjoys over 100 GWs of excess capacity and has a demonstrated track record of building new capacity[7] when needed. In just three years between, between 2001 and 2003, electric generators in the U.S. added 160 GWs of new gas-fired generation.[8] Likewise, the electric industry has a proven track record of timely installing mandated environmental controls. Well over half of the industry already is in compliance and control technology experts have reported that the remaining plants can install controls within the compliance timeline.

To conclude, the Report's scenario assumptions have turned out to be overly aggressive compared to EPA's actual proposed rules, and as a consequence, the Report overstates cost and retirement impacts related to the EPA rules. Nothing in the Report alters our conclusion that the industry is well positioned to comply with the actual regulations on the proposed schedule.

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[7] North American Electric Reliability Corporation ("NERC"), 2009 Long-Term Reliability Assessment: 2009-2018, October 2009.

[8] Energy Information Administration ("EIA") Annual Electric Generation Report: Form EIA-860, 2008. A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet"

[Page 5]

The Results in Context

A. Key Assumptions in the Report Lead to Overstated Retirements and Compliance Costs

EEI prepared its Report before EPA had issued its proposed cooling water intake regulations and Utility Air Toxics Rule. The Report's authors made certain binding assumptions about the impending rules that we now can test against EPA's actual proposals. Although the Report's scenarios were intended to bracket the range of possible outcomes, all nine of EEI's scenarios depict far more aggressive environmental standards than the actual proposed regulations and laws. Indeed, in some cases, EEI's assumptions even conflict with facts known prior to the Report's preparation. For example:

- Six of the nine scenarios[9] modeled (Runs 5-10) contain an underlying assumption that the Waxman-Markey bill went into law, imposing a rising price on carbon dioxide ("CO_2"), starting at $26/ton beginning in 2016. It was well-known in January when the report was carried out, however, that Congress did not enact Waxman Markey and no federal legislation or regulation imposes a price on CO_2.

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[9] The Report includes a reference case and 9 alternative scenarios that reflect different combinations of assumptions regarding EPA regulations and natural gas prices. The six scenarios that reflect a carbon price are the Report's Scenarios: "2"; "2+Alt CO2"; "2+Alt Air"; "2+Alt Ash"; "2+$1.50 gas"; "2+$3.00 gas."

- Eight of the nine scenarios[10] modeled (Runs 2, and 4-10) failed to consider less costly methods of controlling certain air emissions through dry sorbent injection, even though Midwest Generation,[11] one of the largest merchant coal generators in the nation, had announced that these less costly technologies could be deployed to control emissions and would not require plant retirements.

[Page 6]

- Eight of the nine scenarios[12] modeled (Runs 2, 3 and 5-10) assumed EPA would require cooling towers as a "one-size-fits-all" mandate on every U.S. fossil and nuclear power plant over the next decade. Yet, in a December 16, 2010 letter to Congressman Fred Upton, EPA Administrator Lisa Jackson advised Congress that: "I do not favor a onesize- fits-all federal mandate."

Finally, the report ignores an important fact for policymakers to consider: a significant portion of the industry has already installed the types of control equipment anticipated in the new air regulations. Over 150 GWs of the total 320 GWs of coal units in the U.S. have such controls and another 55 GWs are

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[10] Report Scenarios: "1"; "1+Alt Water"; "2"; "2+Alt CO2"; "2+Alt Ash"; "2+$1.50 gas"; "2+$3.00 gas"

[11] In its third quarter 10-Q filed on October 29, 2010, Midwest Generation stated: "Testing of [dry scrubbing with sodium-based sorbents] demonstrated significant reductions in SO_2 emissions and...is expected to require substantially less capital and installation time....", 10-Q at p.55.

[12] Report Scenarios: "1"; "1+Alt Air"; "2"; "2+Alt CO2"; "2+Alt Air"; "2+Alt Ash"; "2+$1.50 gas"; "2+$3.00 gas."

installing the equipment now.[13] In sum, over two thirds of the nation's coal plants are either complying or soon will comply with the regulations and remain in business.

B. Low Natural Gas Prices Drive About 50 Percent of Predicted Retirements

Since 2008, natural gas prices have fallen over 60 percent[14] as a result of the opening up of abundant, new domestic natural gas from shale formations.[15] In turn, low gas prices have been a

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[13] M. J. Bradley & Associates/Analysis Group, "Ensuring a Clean Modern Electric Generation Fleet while Maintaining Electric System Reliability," August 2010, p. 18.

[14] On July 1, 2008, gas peaked at $13.60 per MMBtu its current price is $4.38, or about 68 percent lower.

[15] With new technologies to access the gas, shale gas production has increased 14 fold in 10 years, and the estimated size of the resource base itself has grown more than 20-fold. Compare, for example, the following estimates that indicate the effect of new drilling technologies that increased the estimated size of the accessible U.S. shale gas resource base: 34.7 trillion cubic feet ("TCF:"), estimated by the National Petroleum Council in 2003; 125 TCF320 GWs of capacity,[18] TCF, estimated by ICF International ("ICF") in 2008; 631 TCF, estimated by ICF in 2009; and 827 TCF, estimated by EIA in 2011. Sources: NPC, "Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy, Supply," September 2003, Table S2-21; EIA, Annual Energy Outlook, Early Release Overview, page 1; ICF study for the Interstate Natural Gas Association of American, "Availability, Economics, and Production Potential of North American Unconventional Natural Gas Supplies, 2008, Table 7.

primary driver of wholesale electricity prices being down over 30 percent. [16] In many

[Page 7]
regions of the U.S., efficient natural gas-fired plants are cheaper to operate and are displacing some output from older, less efficient coal plants.

The Report correctly recognizes the impact of these low gas prices on coal plant retirements. [17] Notably, approximately half of the predicted coal plant retirements in "Scenario 1 + Alt Air" is expected to occur due to market fundamentals, even if EPA somehow avoided its legal obligation to promulgate these new rules.

EEI analysis and our own work confirms that we are entering a new era where important natural gas resources that are now economically accessible are triggering a transition in America's power sector from coal to gas *while simultaneously reducing power prices in many parts of the U.S.* Although unwelcomed by some, this transition reflects the use

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[16] The load-weighted energy prices in PJM were $71.13 in 2008 as compared to $48.35 in 2010. *See* Monitoring Analytics, *2009 State of the Market Report for PJM*, Volume 1, March 11, 2010; Monitoring Analytics, *2010 State of the Market Report for PJM*, Volume 1, March 10, 2011. A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet"

[17] According to the Report, 22 GWs of retirements in 2015 and 25 GWs in 2020 "are mostly due...to a generally low natural gas price forecast that makes it uneconomic to continue to operate these typically smaller and older units. These retirements are forecast to occur absent any new air, ash and water regulations". Report, p. 11.

of a domestic fossil fuel (not unlike coal), Nonetheless, this replacement will result in lower emissions and new jobs as old and inefficient power plants are replaced with newer units that are more efficient and that have a lower overall emissions footprint relative to coal. Nearly, 60 percent of the existing coal fleet is over 40 years old – the design life for most units.[18] The oldest and most inefficient of these are generally also the dirtiest, since they have not installed controls in the two decades since President Bush signed the Clean Air Act Amendments of 1990.

These plants – and in some cases, the consumers of their power – have had the economic advantage of operating for decades without modern pollution controls. While understandably attractive to consumers' wallets, these plants emit unhealthful levels of air pollutants, well

[Page 8]
beyond the compliance runway originally envisioned when Congress passed the 1990 amendments to the Clean Air Act.

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[18] M.J. Bradley, *supra*, Table 5, p. 20. Almost 60% of the coal fleet is older than 40 years old with nearly 36% of the fleet older than 50 years old. These older power plants tend to be smaller and less efficient (more costly to operate) than coal plants built in the 1970s or later. These older power plants also disproportionately represent the category of plants without pollution controls and that could be forced to retire as a result of low gas prices and environmental costs. A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet"

Overall, claims of compliance challenges in meeting EPA's deadlines sound reasonable, but do not square with history. A company that begins planning for the Utility Air Toxics rule today (May 2011) will have at least 43 months and as much as 55 months to comply with the final rule.[19] Past experience demonstrates that this time period is ample. For example, in a June 17, 2005 filing with the Georgia Public Service Commission, Georgia Power notified the Commission of its intent to file for permits to install scrubbers at several of its plants and that Georgia Power "expects a three year construction cycle for each scrubber" and needed the scrubbers to comply with federal and state clean air rules "some of which were recently finalized and others of which are still under development."[20] Similarly, Southern Company reported that it installed its Plant Wansley retrofit in about 30 months,[21] and its Plant Crist project in 31 months.[22]

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[19] EPA is subject to a court-imposed deadline to finalize its Utility Air Toxics Rule by November 2011. The Clean Air Act allows three years for existing sources to comply, with the possibility of a unit-specific, one-year extension to complete pollution control installations, for a total of up to 55 months from May.

[20] Letter to Mr. Reece McAlister, Executive Secretary, Georgia Public Service Commission from Oscar C. Harper, Manager, Regulatory Affairs, Georgia Power, June 17, 2005.

[21] See, *Georgia Power cutting emissions at Plant Wansley by 95 percent with new scrubbers*, available at http://times-georgian.com/view/ full_story/3283571/article-Georgia-Power-cutting-emissions-at-Plant-Wansley-by- 95-percent-with-new-scrubbers

[22] This is based on a launch date of May 2007 and a completion date of December 2009. See relevant Southern Company Press Releases available at: http://www.southerncompany.com/news

Southern expects that its Plant Daniel scrubber project should start this year and be operational by late 2014, to comply with EPA's air regulations. [23]

Such time frames are consistent with industry data from construction firms that manage and oversee pollution control installations. According to the Institute of Clean Air Companies

[Page 9]
("ICAC") [24] and AFL-CIO Buildings and Construction Trades Department, [25] labor availability or equipment system availability should not constrain timely implementation of new EPA air regulations. In fact, these groups report that they welcome the substantial employment and economic benefits created by the new infrastructure investment required to modernize the electric generation fleet. Given current low interest rates, surplus equipment, high unemployment in related skill trades, and otherwise favorable conditions produced by low natural gas prices, this happens to be a highly favorable time to invest in a cleaner, more modern generation fleet. These investments

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/iframe_pressroom.aspx and http://www.southerncompany.com /news/iframe_pressroom.aspx

[23] See relevant Mississippi Power Press Release available at: http://www.mississippipower.com/environment/cleaner_air.asp A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet"

[24] See, e.g., the ICAC letter to Senator Thomas Carper, November 3, 2010; http://www.icac.com/files/public /ICAC_Carper_Response_110310.pdf; pp. 1, 3,

[25] See, the AFL-CIO Building and Construction Trades Department letter to Senator Thomas Carper, November 5, 2010.

will produce economic benefits and increase health benefits.

C. EEI's "Scenario 1+Alt Air Case" is the Most Plausible Scenario, But Still Overstates Retirements

We noted previously our concerns about EEI's modeling assumption that the Waxman- Markey bill passed in Congress and became the law of the land. This did not happen, yet two thirds of EEI's modeling scenarios assumed that it has been enacted into law and will go into effect within a few years.

EEI modeled three scenarios that did not include a price on carbon: Scenario 1, "Scenario 1 + Alt-Air" and "Scenario 1 + Alt Water," which respectively produced 56, 46 and 55 GWs of retirements. Taking into account the substantial retirements that relatively low natural gas prices will induce, the factors unrelated to new EPA regulations drive almost half, or in one case even more than half, of the estimated coal retirements:

Table 2
Estimated Coal Plant Retirements Under EEI Alternative Scenarios

Run	Scenario	Total Coal Retirements (GW)		Coal Plant Retirements due to Market Factors (GW)		Coal Plant Retirements (%) due to Market Factors		Incremental Coal Retirements from EPA Regulations (GW)	
		2015	2020	2015	2020	2015	2020	2015	2020
1	Reference Case	22	25	22	25	100	100	0	0
2	Scenario 1 (assuming strict hazardous air pollutant, coal ash, and water regulations)	56	56	22	25	40	45	34	31
3	Scenario 1 + Alt Air (less strict hazardous air pollutant, and otherwise Scenario 1)	46	46	22	25	48	54	24	21
4	Scenario 1 + Alt Water (Fossil and nuclear units of certain size and with once-through cooling that withdraws water from sensitive water bodies must install cooling towers.)	55	55	22	25	40	45	33	30

[Page 10 cont.]

Furthermore, "Scenario 1" and "Scenario 1 + Alt Water" both contain the unrealistic assumption that every coal plant must install a scrubber to achieve air compliance and cannot use less costly technologies (such as TRONA or dry sorbent injection ("DSI")). Many coal fleet owners already have rejected this premise. Others can reasonably be expected to do so. DSI technology has been used successfully for acid gas control for more than twenty years. The Air Toxics Rule allows this less costly compliance option, which can be applied to SO_2, SO_3, sulfuric acid and other acid gases such as hydrochloric acid. This option has been endorsed by major

[Page 11]

technology vendors,[26] and may reduce compliance costs relative to wet scrubbers, especially for units burning low carbon/low sulfur coals.

One scenario ("Scenario 1 + Alt Air") acknowledges these less costly technologies and provides the most reasonable estimate of retirements under the proposed EPA regulations. Even this scenario overstates retirements in light of its assumption that all plants must and eventually will install cooling towers – which is not what EPA has proposed. Thus "Scenario 1 + Alt Air" should be rejected as unreasonable, or at most viewed as the

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[26]http://www.epa.gov/airmarkets/progsregs/epa-ipm/docs/append5_4.pdf, http://www.unitedconveyor.com/CatalogItem.aspx?id=396, http://www.netl.doe.gov/technologies/coalpower/cctc/ccpi/pubs/SOx-NOx%20Reduction%20at%20PIPP%20- %20Topical%20Report%20Final.pdf

upper end of the bracket, not the lowest end as represented in the Report.

D. Putting 24 GWs of Retirements into Perspective

The 24 GWs of incremental capacity in Scenario 1 + Alt Air that is estimated to retire as a result of the EPA regulations represents less than 8 percent of the nation's coal fleet (which totals approximately 320 GWs of capacity[27]). Coal plants generate approximately 45 percent of the total power in the U.S.[28] Notably, between just 2001 and 2003 the U.S. electric industry constructed 160 GW of new combined cycle generation, over six times the amount of retirements predicted under EEI's most plausible scenario.[29]

The Report's scenarios do not consider current electricity demand forecasts. For example, EIA's most recent long-term forecast (2011) lowers the demand forecast for the years

[Page 12]
2015-2020 by 2.5 percent relative to the 2010 forecast used in the Report.[30] Similarly, PJM, the

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[27] M.J. Bradley, *supra*, p. 18.

[28] US EIA Energy Outlook-2011, April 26, 2011.

[29] EIA, Annual Electric Generator Report: Form EIA-860, 2008. A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet"

[30] This is based on evaluating the EIA 2011 AEO's estimates for electricity use in 2015 and 2020 (shown in document ref2011.d120810c), compared to the EIA 2010 AEO's estimates for the same years.

grid operator in parts of the Mid Atlantic/Midwest regions, recently released new forecasts showing that because of economic factors including cost-effective energy efficiency and demand response programs, demand for electricity will be substantially lower than previously forecast.[31] PJM now predicts that some parts of its region will not reach the demand previously forecasted for 2014 until at least 2020.

Furthermore, the Report does not consider that compliance can be achieved not only by building new power plants or retrofitting existing ones, but also through cost-effective demand response, energy efficiency, transmission additions or reconfigurations, or various combinations of strategies. The Report assumes both a static transmission grid (rather than one incorporating the smart grid technologies proposed or already implemented in various parts of the country) and lack of expanded energy efficiency and demand-reduction measures. Advanced smart metering and demand side technologies reduce the need to add capacity for resource adequacy purposes, allow for system operation with greater efficiency and flexibility, and provide customers with more visible price signals to incentivize switching electricity use to less expensive, off peak times.

As many studies have confirmed,[32] demand levels, transmission utilization and demand side

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[31] "2011 PJM Load Forecast Report," PJM Resource Adequacy Planning Department, January 2011.

[32] See, for example, the "Scenario Analyses" performed by the ISO-New England at the request of the New England state regulators, to ensure that that grid operator evaluated the

technologies are critical factors in determining resource adequacy. The Report's failure to consider these relevant factors further reduces the reasonableness of its results.

[Page 13]
Conclusion

Because of various inappropriate and unrealistic assumptions, the Report's scenarios overstate cost and retirement impacts. The scenarios assumed, for example, a one-size-fits-all cooling tower mandate and most scenarios were based on climate change legislation never enacted into law. Neither of these is grounded in real world realities today.

In stark contrast to others that conclude that EPA regulations could lead to 70-80 GW of coal retirements by 2015, we conclude that the most plausible scenario ("Scenario 1 + Alt Air") estimates that there will be no more than 24 GW of incremental retirements from EPA regulations. Even this 24 GW scenario overstates retirements since it assumes that all plants must install cooling towers – which is a more conservative assumption than what EPA has recently proposed.

Moreover, the Report acknowledges that approximately one half of the total retirements predicted under the most plausible scenario result

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implications of various resource options on reliability requirements and system production costs. http://www.isone.com/committees/comm_wkgrps/othr/saas/mtrls/elec_report/scenario_analysis_final.pdf. A Peer Review of EEI's "Potential Impacts of Environmental Regulation on the U.S. Generation Fleet"

from market fundamentals – primarily low gas prices and will occur absent any new EPA regulations. To put the incremental 24 GW of retirement into context, there is currently over 100 GW of excess capacity in the US and a proven history of building new capacity when needed. Accordingly, nothing in the Report changes our conclusion that the industry is well-positioned to comply with the actual regulations on the proposed schedule and yield significant benefits to the Nation.

Part 3 of 3

COMMENTS OF EXELON CORPORATION ON U.S. ENVIRONMENTAL PROTECTION AGENCY'S PROPOSED NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FROM COAL- AND OILFIRED ELECTRIC UTILITY STEAM GENERATING UNITS AND STANDARDS OF PERFORMANCE FOR FOSSIL-FUEL-FIRED ELECTRIC UTILITY, INDUSTRIALCOMMERCIAL-INSTITUTIONAL, AND SMALL INDUSTRIALCOMMERCIAL-INSTITUTIONAL STEAM GENERATING UNITS

Docket ID No. EPA-HQ-OAR-2009-0234 and
Docket ID No. EPA-HQ-OAR-2011-0044
76 Fed. Reg. 24,976 (May 3, 2011)

Exhibits 21 – 27

August 4, 2011

EXHIBIT 21

To Comments Of Exelon Corporation On Docket ID No. EPA-HQ-OAR-2009-0234 and Docket ID No.EPA-HQ-OAR-2011-0044 76 Fed. Reg. 24,976 (May 3, 2011)

Charles J. Cicchetti, "Why EPA's Mercury and Air Toxics Rule is Good for the Economy and America's Workforce," (July 2011) ("Cicchetti Report")

* * *

[Page 3]

Executive Summary

EPA's proposed Mercury and Air Toxics Rule would limit emissions of hazardous air pollutants including mercury; non-mercury metals such as lead, arsenic, cadmium, chromium, manganese, selenium and nickel; and acid gases such as hydrogen chloride, hydrogen fluoride and hydrogen cyanide from electric generating units. Emissions of these toxic substances severely harm human health and can result in premature death, birth defects, respiratory illness and heart attacks. Our Nation and most others have determined that these toxic pollutants should be eliminated from the atmosphere and the food supply to the greatest extent reasonably possible. To do so, the electric industry will need to respond, either by installing emissions control technology, switching to lower polluting fuels, retiring older, less efficient and more polluting plants, switching dispatch to reduce

emissions and/or implementing measures to improve energy efficiency. In addition to reducing emissions of hazardous air pollutants, these actions would result in significant reductions of other harmful air pollutants, including SO_2, NO_x, particulate matter (PM), and greenhouse gas (GHG) emissions. This, in turn, would produce substantial opportunity benefits (co-benefits) in the form of additional avoidance of low probability premature death, and other health and welfare improvements.

Rather than moving forward with these actions, however, coal plant owners continue to seek delay in the implementation of EPA's emissions standards for hazardous air pollutants and resist EPA every step of the way. Political allies of coal seek to delay implementation of the Toxics Rule and EPA's recently promulgated Cross-State Air Pollution Rule by at least a year and a half through legislation, commonly referred to as the Train Act, as well as other similar legislative efforts to delay rules that already are years late. Companies that have gotten away with and even benefitted from avoiding the consequences of the pollution that they emit challenge EPA's benefit-cost analyses for its proposed Toxics Rule. This report evaluates EPA's

[Page 4]
benefit-cost analysis as well as quantifies additional benefits that EPA chose not to monetize or include in their final benefit-cost results. EPA's analysis is both comprehensive and conservative, and the proposed Toxics Rule would result in an additional $10.5 billion in annual benefits that EPA did not quantify or include in its analysis.

EPA, nevertheless, concluded that the annual benefits of the proposed Toxics Rule would dwarf the compliance costs, yielding net benefits (benefits minus costs) of about $42 billion to $129 billion per year. Some have argued that EPA's benefit-cost analysis is faulty because it includes co-benefits from SO_2, NO_x, particulate matter (PM), and greenhouse gas (GHG) emissions, which are not directly regulated by the proposed Toxics Rule. Those who suggest that it is improper for EPA to calculate co-benefits from reductions of non-hazardous pollutants, which are regulated under other sections of the Clean Air Act, have a fundamental lack of knowledge of the core economic concept of opportunity benefits and a poor understanding of how to conduct an benefit-cost or economic impact analysis.[1] EPA's benefit-cost analysis is comprehensive and relies upon sound and proven scientific methods and data.

Moreover, EPA's benefit-cost analysis was extremely conservative. EPA ignores the likely overestimate of compliance costs and likely underestimate of realized benefits of the proposed Toxics Rule and fails to substitute a reasonable degree of new energy efficiency and demand-side management. Because it already had enough information to conclude that the benefits of the proposed Rule far outweigh the costs, EPA also chose not to quantify many additional benefits. In this Report, we identify an additional $8.2 billion in

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[1] As discussed in Section I, it is contrary to both sound principles of benefit-cost analysis and common sense to suggest that "co-benefits" arising from the Rule should not be considered.

annual benefits plus $2.3 billion in likely energy efficiency savings resulting from EPA's proposed Toxics Rule. These include the combined employer business savings for lost workdays, employee recruiting, training, integration, and replacement, and avoided restricted outdoor activities; reduced health

[Page 5]
care and insurance costs, and increased employment at a time when the economy is stressed. (See Table 8). This study also examines some of the second and third order effects that EPA did not calculate. The additional analysis in this Report shows that the proposed Toxics Rule would add 115,520 jobs, GDP growth of $7.170 billion, and additional tax receipts of $2.689 billion. These results are summarized in the following table:[2]

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[2] Moreover, the proposed Toxics Rule will produce even greater benefits that have not been fully monetized in either the EPA analyses or this Report. For instance, additional benefits will result from structural shifts in the electric generation industry as a result of the replacement of antiquated coal-fired plants with new, more efficient gas-fired plants located in the areas of the shale gas boom. For example, up to nine coal-fired plants that are located in Pennsylvania, Ohio, West Virginia, and New York and projected by the RIA to retire as a result of the Toxics Rule are located above the Marcellus Shale Gas Formation, the Utica Shale Gas Formation, or both. New combined cycle gas fired power plants at these sites could take advantage of existing transmission lines and locally produced natural gas.

[Page 5 cont.]

	EPA Calculations in RIA	Adding Energy Efficiency ($2.3 million in 2015)	Adding Additional Analysis in this Report
Net Benefits	$42-$129 billion	$44.3-$131.3 billion	$52.5-$139.5 billion
Job Increases	35,970	n/a	115,520
Healthcare Savings	$3.445 billion	n/a	$4.513 billion
GDP Increases	n/a	n/a	$7.170 billion
Increased Tax Revenues	n/a	n/a	$2.689 billion

The damage caused by hazardous air pollutants cannot easily be measured in dollars and cents. But the benefits of reducing exposure to toxic pollutants can be quantified, as EPA has done in its RIA and we have added upon here. The Toxics Rule will reduce public exposure to hazardous pollutants and save lives at no cost to Americans, but, quite the contrary, will produce significant economic benefits. It therefore should be promptly adopted and enforced. Delay is not an option for America's economy or its workforce.

[Page 6]

Introduction: The Compelling Case for the EPA's Toxics Rule

The Environmental Protection Agency (EPA) has issued a proposed rule establishing national emission standards for hazardous air pollutants (HAPs) from coal- and oil-fired electric utility steam generating units (EGUs) under Clean Air Act (CAA) section 112 and new source performance standards for non-greenhouse gas pollutants from fossil fuel-fired EGUs under CAA section 111(b). These are, collectively, referred to as the Toxics Rule.

The appropriate economic test to determine policies that eliminate toxic substances is the least-cost test. The societal goal should be to avoid the release of HAPs using the lowest reasonable cost options. EPA's approach to regulating HAP emissions and performing the required RIA conceptually should be quantitatively and qualitatively different from its analysis of other air pollutants. This difference is reflected in the special statutory provisions in the CAA governing HAPs. It is also consistent with other statutory provisions directed at many of the substances affected by the Toxics Rule. For example, the Mercury Export Ban Act and the Mercury Containing and Dischargeable Battery Management Act of 1996 both place strict limits on the proliferation of mercury and reflect a legislative judgment that these limits are a high priority. Similarly, the Consumer Product Safety Act Amendments of 2008 place very strict limits on lead coatings and other potential vectors of exposure to lead and other dangerous metals.

Other federal agencies have applied strict scrutiny to the substances at issue here and have imposed stringent regulations. For example, the Food and Drug Administration has a currently effective advisory admonishing pregnant women and young children to avoid consuming certain species of fish entirely because of the potential for mercury exposure. The Occupational Health and Safety Administration has extremely strict workplace rules governing the substances controlled by the Toxics Rule. The Consumer Product Safety Administration has

[Page 7]
imposed enormous expense on the paint and coatings industry and upon the toy industry and retailers due to product recalls, testing and certification requirements, and other regulations all designed to minimize or eliminate exposure to lead and other dangerous substances. Finally, state and local governments have also enacted stringent restrictions on many of these toxic substances. In many of these cases, the cost per unit of reduced exposure is likely much higher than in the Toxics Rule, but society has made a judgment through the political process that eliminating this danger is well worth the price. These statutes and regulations reflect the implicit value that society places upon reducing human exposure to hazardous substances.

Society's judgment that reducing human exposure to hazardous substances is of high value is not the product of a whimsical or poorly reasoned decision. History tells us that some of the HAPs regulated by the Toxics Rule can produce truly

catastrophic human health disasters. In Japan, a notorious outbreak of mercury poisoning was so severe that it was classified as a distinct disease – the Chisso-Minamata disease, named after the primary polluting company and the area primarily affected. It is estimated that there were nearly 2,000 fatalities and many, many more cases of severe neurological damage. A second outbreak also affected a large number of victims. Lead poisoning has been a notorious and vicious source of human health damage, especially in urban areas.

Toxic pollutants should not be and are generally not controlled by effluent taxes or by cap and trade mechanisms more appropriate to other substances for which calculating an economically optimal level can be undertaken. Instead, emissions of hazardous substances that can create severe human health hazards should be eliminated from the atmosphere and the food supply to the greatest extent reasonably possible.

Public policy can reasonably seek to achieve a balance between costs and benefits for some environmental pollutants. Environmental economics evokes a conceptual tradeoff between marginal abatement costs and marginal damages to establish conceptually the economically

[Page 8]
efficient pollution reduction target or standard and various means to accomplish the goal. While these analyses and policy objectives can be subject to legitimate debate concerning the "optimal" result, this is clearly not the case here. The measures EPA is required to take under the CAA do not lend

themselves to such balancing because hazardous substances represent clear and direct dangers to the exposed population. The public policy objective for toxics is to find the least cost means to prevent the release of these toxic substances into the environment.

In this case, EPA has shown that removing these toxic poisons would produce enormous net benefits in excess of costs. This means compliance with the Toxics Rule costs society a negative amount to restrict the release of the hazardous substances the Toxics Rule addresses. Therefore, EPA has proposed a method of reducing hazardous air pollutants at the least cost. Completely aside from the benefits associated with the actual reduction of HAP exposure itself, technologies are available to achieve compliance with the Rule at reasonable costs. In addition, deploying these technologies would reduce $PM_{2.5}$ significantly (even after full compliance with the Transport Rule) and the benefits associated with that reduction significantly exceed the total costs of deploying the technology. Thus, the issue could appropriately be framed as whether Americans would like to be paid (the net benefits of deploying the technology) in order to have less mercury and other heavy metals in their food and less of these metals and dangerous acids in the air they breathe. In a very important sense, this is a free lunch!

Even this compelling analysis understates the Rule's net benefits. While EPA's analysis of the human health benefits of the Toxics Rule is sound, EPA does not include other significant resulting economic benefits. This study shows these additional

benefits include reducing employers' labor costs, increasing local and state tax revenues, and reducing employers' health insurance costs and total approximately $8 billion per year. In addition, the RIA understates the potential importance of new energy efficiency and demand-side management alternatives and related cost-savings, and includes no consideration of likely technological innovations.

[Page 9]

EPA has provided an example of the IQ-related benefits for children born to mothers with particularly high exposure to mercury in their food chain. This analysis is important, but merely scratches the surface of the myriad of concentrated damages that exposure to mercury and nonmercury heavy metals cause for the poisoned individuals and their children in utero. For some unfortunate population groups, exposure to hazardous substances can be poisonous in a direct manner, and not in just a probabilistic fashion as with other air pollutants. Thus, the enormous net benefits that EPA has calculated for the Toxics Rule are, in fact, substantially understated.

[Page 10]

Section I. The Monetized Benefits of EPA's Toxic Rule Far Outweigh the Costs

EPA's core mission is protecting human life, health, and the environment. Many of the conventional pollutants that EPA regulates can be treated in terms of comparing the direct benefits and costs of reducing their concentration in the environment. For this category of pollutants, it is quite reasonable to ask questions such as: How much

pollution control or permitted emissions are optimal? Other pollutants, however, are hazardous in the important sense that they poison and directly harm people and other species that are exposed to these toxic materials. For this category of pollutants, the question becomes: "What is the least cost of removing the toxic material from the threatened population?"

In the RIA of the Toxics Rule, EPA did two things. First, EPA recognized accurately that the proper question to ask when toxic poisons are entering the environment is: "What is the least cost means for preventing these toxic pollutants from entering the environment and exposing people and other species from direct harm?" EPA also poses a second critical question in its RIA tied to the fact that there are additional benefits that would offset the necessary costs for avoiding the release of toxic poisons: "Do health-related savings from curbing pollution emissions exceed compliance costs?" The EPA analysis answers this with a very strong and unambiguous "yes", even when focusing only on the morbidity and mortality effects of increased concentrations of $PM_{2.5}$ and ground level ozone. This is most important because it means that the net costs to the nation from curbing the release of toxic substances from the nation's coalfired power plants is very much an additional benefit.

EPA's benefit-cost analysis of the Toxics Rule is consistent with EPA's Guidelines for Preparing Economic Analyses (Guidelines).[3] The Guidelines

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[3] Guidelines for Preparing Economic Analyses, United States Environmental Protection Agency, Office of the Administrator, EPA 240-R-10-001, December 2010.

(Section 8.1) conclude: "The most comprehensive measure of the costs of regulation – and thus the appropriate measure to use in a

[Page 11]
benefit-cost analysis – is 'social cost'...it may be defined as the sum of all opportunity costs incurred as a result of the regulation." The term opportunity cost in benefit-cost applications can be positive (benefit) or negative (cost). Section 5.71 concludes "In some cases, however, compliance implies a reduction in costs from the baseline." This would be an additional cobenefit or opportunity benefit that would be added to the direct program benefits or subtracted from the costs. Either would yield an identical net benefit calculation. The Guidelines also explain (in Section 5.8) that "Developing a baseline plays a critical role in analyzing policy scenarios, because it is the basis for benefit-cost analysis and options selection." The definition of baseline (Section 5.5 of the Guidelines) is that it "is a reference point that reflects the world without the proposed regulation..." The baseline for the Toxics Rule is the implemented Transport Rule.

Any additional benefits related to cleaner air as a result of the Toxics Rule would be cobenefits or opportunity benefits. These are included in a properly formulated benefit-cost analysis. EPA got this correct in the RIA.

In the analyses of the Toxics Rule, three factors are important in the benefits-cost analysis. These are: (1) benefits of reduced toxic materials; (2) cost of toxics reduction; and (3) other direct opportunity effects or changes, such as co-benefits, in baseline

related to the reduction in toxic materials. The RIA reflects these economic principles by defining baseline as a fully implemented Transport Rule; and adding the additional opportunity benefits or cobenefits under the Toxics Rule related to reduced air pollutants, particularly $PM_{2.5}$ and ozone [4]

Put simply, EPA proves with sound science and clear economic reasoning that levels of toxic emissions in this nation can be sharply reduced with no net costs. EPA and others correctly

[Page 12]
show there is a strong and undeniable link between the policies that reduce toxic substances in the environment and the further reduction in harmful particulates and ozone in the air we breathe. In its RIA, EPA properly and logically established a baseline. The RIA cites extensive evidence that demonstrates conclusively there would be significant reductions in concentrations of the harmful particulate and ozone-related air pollutants beyond the baseline of EPA's new Transport Rule. The added opportunity benefits significantly increase health and related economic benefits beyond the Transport Rule. When netted against the direct costs for the electric generating units, the least cost for reducing toxic poisons is negative. This should end the debate without even attempting to monetize the benefits of eliminating toxic poisons placed in our environment.

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[4] As discussed further below, comments suggesting that the opportunity benefits (which EPA calls "cobenefits") of reducing pollutants that are not HAPs should not be considered in evaluating the proposed Rule are completely inconsistent with sound principles of benefit-cost analysis.

As detailed below, using peer-reviewed scientific and economic evidence, EPA concludes in its Toxic Rule RIA that the annual benefits of reducing premature deaths and illnesses beyond the Transport Rule exceed compliance costs many times, making implementing the Toxics Rule effectively a free pass.

Based on an independent review of EPA's detailed and extensive economic analysis in the Toxics Rule RIA, this Report concludes that EPA's models, methods, sensitivity analyses, and data meet and surpass the professional and scientific requirements of independent peer review. Further, independent sensitivity analysis of several critical components of EPA's benefit-cost analysis confirms that EPA's analysis is reasonable and conservative; that likely the Toxics Rule's benefits are understated and its compliance costs overestimated; and that the benefits of the Toxics Rule far outweigh the compliance costs, which are net negative under any reasonable set of assumptions.

A. EPA's Net Benefit Assessment Methodology Meets or Exceeds the Standard for Peer Review.

The purpose of the Toxics Rule is to reduce the national emissions of HAPs from coaland oil-fired electric generating plants. This includes reducing emissions of mercury, lead,

[Page 13]
arsenic, cadmium, chromium, selenium, cobalt, nickel, hydrochloric acid, hydrofluoric acid and hydrogen cyanide. The Toxic Rule would also, as a secondary or direct opportunity benefit, reduce SO_2

and NO_x emissions, which react in the atmosphere to form fine particle pollution ($PM_{2.5}$)[5] and ground level ozone (smog). $PM_{2.5}$ can be deeply inhaled, absorbed, and passed through the blood stream to susceptible organs in the body causing premature deaths, serious illnesses such as chronic bronchitis and heart attacks, and numerous respiratory problems. $PM_{2.5}$ can also travel in the air stream hundreds of miles. Similarly, because the chemical reactions that create ground level ozone take place when wind blows the pollutants through the air, ground level ozone can be even worse miles away than at the source of the emissions. The first air pollution and mortality studies that conclusively established links between air pollutants and human health[6] in the 1970's were primarily based upon statistical correlation. Recently, the focus has shifted to causation, a more scientific approach that analyzes the harm to humans through deep inhalation of such fine particles in the air.

In its RIA, following extensive evaluation of the vast body of authoritative scientific research, EPA estimated that in 2014 the Toxics Rule would protect public health and avoid: 6,800 – 17,000[7] premature

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[5] $PM_{2.5}$ refers to fine particles with a diameter of 2.5 microns or less. A micron is one-millionth the size of a meter, which is about 1% of the width of a human hair.

[6] Lester Lave and Eugene Seskin with support from Resources for the Future (RFF) established the statistical links between air pollutants and human health in a variety of studies summarized in their 1977 book: Air Pollution and Human Health, Baltimore: the Johns Hopkins University Press for Resources of the Future.

[7] RIA page 1-1.

deaths; 11,000[8] cases of acute bronchitis; 11,000[9] non-fatal heart attacks; 12,200[10] hospital admissions and ER visits; 850,000[11] days when people miss work or school; 110,000[12] cases of aggravated asthma; and 225,000[13] cases of upper and lower respiratory symptoms. EPA used this information to calculate that the Toxics Rule would

[Page 14]
provide mortality and morbidity annual health and welfare benefits of between $58 and $140 billion more than the baseline Transport Rule[14] These are summarized in the RIA's Table 6-18, (as corrected by the EPA's Errata of March 23, 2011) which is reproduced below.

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[8] RIA, page 6-83, Table 6-17.

[9] RIA, page 6-83, Table 6-17

[10] RIA page 6-93, Table 6-17.

[11] RIA page 6-83, Table 6-17.

[12] RIA, page 6-83, Table 6-17.

[13] RIA, page 6-83, Table 6-17

[14] RIA, page 1-1.

Table 6-18. Estimated Economic Value of Health and Welfare Benefits (95% confidence intervals, billions of 2007$)[a]

Health Effect		*Eastern U.S.*[b]	*Western U.S.*	*Total*
Adult premature death (Pope et al. 2002 PM mortality estimate)				
3% discount rate	$PM_{2.5}$	$53 ($4.2—$160)	$0.9 ($0.1—$2.8)	$54 ($4.3—$160)
7% discount rate	$PM_{2.5}$	$48 ($3.8—$140)	$0.8 ($0. 1—$2.5)	$48 [9?] ($3.8—$150)
Adult premature death (Laden et al. 2006 PM mortality estimate)				
3% discount rate	$PM_{2.5}$	$140 ($12—$390)	$2.4 ($0.2—$6.9)	$140 ($12—$400)
7% discount rate	$PM_{2.5}$	$120 ($11—$350)	$2.2 ($0.2—$6.3)	$120 ($11—$360)
Infant premature death [was this done at 3 and 7% rates?]	$PM_{2.5}$	$0.3 ($-0.3—$1.2)	<$0.01	$0.3 ($-0.3—$1.2)
Chronic Bronchitis	$PM_{2.5}$	$2.1 ($0.1—$9.6)	$0.05 (<$0.01—$0.2)	$2.1 ($0.1—$9.8)
Non-fatal heart attacks				
3% discount rate	$PM_{2.5}$	$1.2 ($0.2—$2.9)	$1.2 ($0.2—$2.9)	$1.2 ($0.2—$2.8)
7% discount rate	$PM_{2.5}$	$1.1 ($0.2—$2.8)	$1.2 ($0.2—$2.9)	$1.1 ($0.2—$2.8)
Hospital admissions—respiratory	$PM_{2.5}$	<$0.01	<$0.01	$0.02 ($0. 01—$0.03)
Hospital admissions—cardiovascular	$PM_{2.5}$	<$0.01	<$0.01	$0.1 ($0.05—$0.14)

Acute bronchitis	$PM_{2.5}$	<$0.01	<$0.01	<$0.01
Lower respiratory symptoms	$PM_{2.5}$	<$0.01	<$0.01	<$0.01
Upper respiratory symptoms	$PM_{2.5}$	<$0.01	<$0.01	<$0.01
Asthma exacerbation	$PM_{2.5}$	<$0.01	<$0.01	<$0.01
Lost work days	$PM_{2.5}$	$0.1 ($0.1—$0.1)	<$0.01	$0.1 ($0.1—$0.1)
Minor restricted-activity days	$PM_{2.5}$	$0.3 ($0.2—$0.5)	<$0.01	$0.3 ($0.2—$0.5)
CO_2-related benefits (3% discount rate)	CO_2			$0.57
Monetized total Benefits (Pope et al. 2002 $PM_{2.5}$ mortality estimate)				
3% discount rate		$57 ($4.6—$170)	$1 ($0.1—$3.1)	$58 ($4.6—$180)
7% discount rate		$52 ($4.1—$160)	$0.9 ($0.1—$2.8)	$53 ($4.2—$160)
7% discount rate		$52	$0.9	$53

	($4.1—$160)	($0.1—$2.8)	($4.2—$160)

Table 6-18. Estimated Economic Value of Health and Welfare Benefits (95% confidence intervals, billions of 2007$)[a] (continued)

Health Benefit	*Eastern U.S.*[b]	*Western U.S.*	*Total*
Monetized total Benefits (Laden et al. 2006 $PM_{2.5}$ mortality and Levy et al. 2005 ozone mortality estimates)			
3% discount rate	$140 ($12—$410)	$2.5 ($0.2—$7.2)	$140 ($12—$410)
7% discount rate	$130 ($11—$370)	$2.2 ($0.2—$6.6)	$130 ($11—$370)

[a] Economic value adjusted to 2007$ using GDP deflator. Estimates rounded to two significant figures. The negative estimates for certain endpoints are the result of the weak statistical power of the study used to calculate these health impacts and do not suggest that increases in air pollution exposure result in decreased health impacts. Confidence intervals reflect random sampling error and not the additional uncertainty associated with benefits scaling described above. The net present value of reduced CO2 emissions are calculated differently than other benefits. The same discount rate used to discount the value of damages from future emissions (SCC at 5, 3, 2.5 percent) is used to calculate net present value of SCC for internal consistency. This table shows monetized CO2 co-benefits at discount rates at 3 and 7 percent that were calculated using the global average SCC estimate at a 3% discount rate because the interagency workgroup on this topic deemed this marginal value to be the central value. In section 6.6 we also report the monetized CO2 co-benefits using discount rates of 5 percent (average), 2.5 percent (average), and 3 percent (95th percentile).

[b] Monetary value of endpoints marked with dashes are < $100,000

[Page 16 cont.]

EPA uses only peer-reviewed scientific models and methods to estimate how changes in ambient air concentrations of air pollutants result in health benefits. EPA's quantitative and qualitative models, sensitivity analyses, and data meet and surpass professional and scientific requirements of independent peer review. In determining the impact of increasing concentrations of harmful pollutants by adding transported upwind emissions to locally produced downwind emissions, the EPA followed the widely-accepted science of concentration-response ("C-R"). Under the C-R approach, the "odds," or relative risk, of premature death or illnesses increase exponentially.

EPA's Health Impact Analysis uses an air quality model called CAMx (Comprehensive Air Quality Model with Extensions) that projects "$PM_{2.5}$ and ozone air quality" and estimates "the change in the spatial distribution of the ambient air quality." This approach determines the

[Page 17]

change in exposure to populations, and calculates the health effects.[15] The estimated concentrations of both primary and secondary particles in the atmosphere reflect geographically dispersed meteorological inputs such as wind speed and direction, temperature, moisture, vertical diffusion, and rainfall.

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[15] RIA at pages 6-6 through 6-7.

The CAMx results are combined with the AIRS (Aeromatic Information Retrieval System) model to estimate ground level ozone concentrations. EPA's peer-reviewed quantitative benefits model (BenMAP) determines the different health and social consequences of implementing the Toxics Rule based upon estimated differences in concentrations of $PM_{2.5}$ and ground level ozone using the conservative assumption that the Transport Rule has been fully implemented.

Table 1, which reproduces portions of EPA's RIA Tables 8-4 and 3-12, shows the significant power plant reductions in SO_2 and NO_x emissions from implementing the Toxics Rule as calculated by EPA using these conservative, tested, and sound scientific methods.

TABLE 1
Summary of Emissions Changes for the Toxics Rule in Lower 48 States

Item	Pollutant	
	NO_x	SO_2
2015 EGU Emissions		
Base Case After Implementing Transport Rule	2,000,000	3,900,000
Further Reductions for Toxics Rule	100,000	1,100,000
Further Percentage Reductions with Toxics Rule	5.0%	28.2%
Total 2014 Man-made Emissions*		
Base Case with Transport Rule	Not Reported	6,288,530
Control Case with Toxics Rule	Not Reported	3,931,211
Percentage Reduction with Toxics Rule	N/A	37.5%

* In this table, man-made emissions includes average fires

Based on these substantial SO_2 and NO_x emission reductions, and using sound scientific and proven methodology discussed at length in Section I (B) of this report, EPA also calculated that implementing the Toxics Rule could prevent 6,800 to 17,000 premature deaths per year, as shown in the following Table 2[16]. EPA applied similar peer reviewed and widely accepted scientific techniques to determine the incidence and health care costs for increased illness and

[Page 19]
morbidity. These are included in the opportunity benefits discussed above that EPA often refers to as co-benefits.

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[16] EPA uses two significant digit rounding. Therefore the combined premature deaths estimated for ozone and $PM_{2.5}$ equal the number of premature deaths for adults and children combined and attributable to ozone and $PM_{2.5}$ combined. Annual ozone-related premature deaths and infant $PM_{2.5}$ are both less than 500 deaths per year, so that those numbers round down to zero when combined with the adult $PM_{2.5}$ numbers.

TABLE 2

Toxic Rule Reductions in Annual Premature Mortality *

Fine Particles

	Source	Range	Midpoint
(1)	Pope, et al 2002 >30	1,900 - 12,000	6,800
(2)	Laden, et al 2006 >25	8,100 - 27,000	17,000
(3)	Infant	30	30

* Source for PM and Ozone premature mortality estimates is Table 6-17, page 6.83 of the RIA.

[Page 19 cont.]

In the public comment sessions, the Electric Reliability Coordinating Council ("ERCC"),[17] echoing other opponents of the Toxics Rule, suggested it was somehow improper for EPA to calculate co-benefits or opportunity costs to the extent the co-benefits that arise from reductions of pollutants might be regulated under other sections of the Clean Air Act. This comment reflects a lack of knowledge of the core economic concept of opportunity benefits and a poor understanding of how to conduct an economic impact analysis. In fact, it would be improper to fail to account for these co-benefits because they amount to net negative costs of implementing the regulation. This is known as joint products in the economic literature. It is

[Page 20]

exemplified by considering the calculation that a lead smelting company might make in deciding whether or not to develop a new mine rich in lead, where the new vein also included silver and other valuable metals. Although the company would be developing the mine to supply its lead smelter, it would base its investment decision on the total return, which would require considering the present value of all costs and revenues, which would necessarily consider revenues from the sale of the silver and other non-lead minerals. Even assuming that the non- HAP and HAP benefits could be segregated, it would make little sense for society to ignore the benefits of

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[17] This group does not represent the utility industry but, based on its website, is a coalition of unnamed parties formed with the express purpose of challenging EPA regulation of the industry.

reducing $PM_{2.5}$ and NO_x just as it would make little sense for the lead company to ignore the value of the jointly producible silver.

B. Independent Review of Several Critical Issues Confirms that EPA's Methodology is Reasonable and Conservative.

A comprehensive review of EPA's analysis confirms its net benefit methodology for valuing annual mortality and morbidity health and welfare benefits is reasonable and conservative. In particular, an independent review of EPA's: (1) baseline conditions; (2) explicit value of human life that drives its numbers; (3) quantitative omission of some benefits; and (4) conservatively high compliance costs, verifies that the health co-benefits associated with reducing $PM_{2.5}$ alone from the Toxics Rule far exceed compliance costs under any set of reasonable assumptions, and that the Agency's approach is conservative because it tends to understate benefits and overstate costs. Under highly probable conditions, the analysis indicates that refining EPA's estimates would likely mean that Toxics Rule benefits would exceed compliance costs by about 5 to 13 times.

1. Baseline Conditions

EPA's baseline assumes that the Transport Rule is in effect and includes reductions in ground level ozone and $PM_{2.5}$ pollution from all other federal and state requirements in place as of 2010. Thus, the baseline case takes into account the emissions reductions associated with the

[Page 21]
Transport Rule and the co-benefits EPA calculates for the Toxics Rule are in addition to the benefits achieved through implementing the Transport Rule. Similarly, the costs associated with the reductions required by the Transport Rule are not included in calculating the costs of the Toxics Rule.[18]

2. EPA Used a Reasonable Value of Statistical Life (VSL)

The value of statistical life ("VSL") EPA used in calculating the value of fewer premature deaths represents the largest share of the Toxics Rule's opportunity or co-benefits. Accordingly, we conducted an independent sensitivity analysis on this key variable. This analysis concludes that EPA's VSL methodology represents current state-of-the-science.

Although important work continues in refining monetization of the value of premature loss of life, the EPA's VSL analysis was vetted fully, subjected to robust peer review in the scientific community, and applies the most scientifically objective methodology for valuing human life currently available. Even if EPA had selected an unreasonably low VSL value, the Toxics Rule benefits still far outweigh the compliance costs. When the monetized opportunity

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[18] As we noted in our report on the Transport Rule, Charles J. Cicchetti, *Expensive Neighbors: The Hidden Cost of Harmful Pollution to Downwind Employers and Businesses*, (Dec. 2010), EPA properly determined that the benefits of the Transport Rule far outweighed its benefits. Because the costs and benefits of the Toxics Rule are marginal, if one considered the combined impacts of the two rules, the benefits would far outweigh the costs.

benefits related to cleaner air are subtracted from the additional conservatively estimated compliance cost, the net costs are extremely negative, even without monetizing the effect of poisonous HAPs that bio-accumulate and persist in the environment and food chain.

EPA's VSL relies conceptually on two critical issues: (1) reducing the risks of premature death (*i.e.*, the effect of a "small reduction in risk on a large number of people"); and (2) the "willingness of people to pay" (WTP) to reduce such risks. It is important to understand that the VSL evaluation represents payments (*i.e.*, a relatively small individual WTP[19] across all the

[Page 22]
potentially affected populations) to reduce the risk of premature death, rather than an attempt to determine the value of a specific human life.

Consider an example. Suppose one million people are each willing to pay $100 per year to reduce the risk of deaths from twenty per million people to ten per million people. The sum of WTP equals $100 million per year and the reduction in expected deaths is 10 per year, so the VSL would be $10 million per

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[19] The three approaches to determine WTP are: (1) Wage-Risk Studies, which compare relative salary differences to different fatal injuries, adjusting for confounding factors in the regression analysis; (2) Continent Valuation Studies, which pose hypothetical questions related to risk, hypothetical insurance premiums, changes in monetary remuneration, etc.; and (3) Consumer Market Studies, which examine the actual economic trade-offs people make between risks and benefits in their product consumption and insurance decisions.

person ($100 million divided by 10 people per year). The EPA relied on its Guidelines for Preparing Economic Analyses (U.S. EPA 2000) (Guidelines) to determine the Toxics Rule VSL.[20] EPA's Scientific Advisory Board ("SAB") vetted and endorsed the VSL in the Guidelines for Preparing Economic Analyses.[21] These Guidelines have been peer-reviewed and fully vetted. They represent state-of-the-science values and methods for the performance of economic analysis, and the EPA has properly applied them.

The EPA used sound scientific methods to determine the VSL estimates including a "meta analysis" of 26 "high-quality" studies conducted between 1974 and 1991, which estimated a value of mortality risk reduction.[22] Each study was peer-reviewed, tested, and endorsed by the SAB. The EPA Guidelines recommend updating the $4.8 million (1990$) figure for VSL for inflation to the base year of the benefit analysis yields a VSL of $6.3 million in 2000$.[23] EPA reasonably derived a VSL of $7.8 million after adjusting a VSL of $6.3 million in 2000 dollars to 2006 dollars.[24]

[Page 23]

(i) EPA Uses a Reasonable Approach to Calculate the Number of Avoided Premature Deaths

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[20] RIA at page 6-36.

[21] RIA at page 6-36.

[22] See Guidelines for Preparing Economic Analyses, Exhibit 7-3 Value of Statistical Life Estimates (mean values in 1997 dollars), page 89 (September 2000). RIA page 6-36.

[23] RIA at page 6-36.

[24] RIA at page 6-36, footnote 2.

The value of the VSL is a critical variable in EPA's cost/benefit calculations because health-related and, in particular, mortality-related benefits, dominate the estimated benefits for the Toxics Rule. The Toxics Rule RIA estimated that in 2016 approximately 6,800 to 17,000 premature deaths would be avoided nationwide. Avoiding these premature deaths represents about $53 billion[25] of the $59 billion, or nearly 90% of the low case's estimated benefits for the 3% discount case. The corresponding estimates for the high case are $133 billion[26] for premature mortality out of $140 billion in annual benefits, or about 95% for the 7% discount case[27]

EPA's approach to estimate the number of avoided premature deaths is called a Concentration-Response ("C-R") method. This widely endorsed method, which has been used extensively in the epidemiology, public health, and economics fields, uses a log-linear function. Such an approach is consistent with a low incidence of low exposure that increases exponentially until a threshold is approached and incidence again slows. The EPA's low case (6,800 deaths per year) relies upon American Cancer Society data and a 2002 peer-reviewed study published in the Journal of the

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[25] This equals 6,800 premature deaths per year times $7.8 million in VSL.

[26] This equals 17,000 premature deaths per year times $7.8 million in VSL.

[27] See Table 6-18 of the Toxics Rule, RIA at page 6-84.

American Medical Association ("Pope Study").[28] The EPA's high case (17,000 deaths per year) is based on data from a 2006 Harvard study published in The American

[Page 24]
Journal of Respiratory and Critical Care Medicine, which covered six cities and was peerreviewed ("Laden Study").[29]

The Toxics Rule RIA uses two ranges for mortality estimates: the low range uses the 2002 Pope Study for $PM_{2.5}$ mortality and Bell[30] for ozone;

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[28] See Pope, C.A., III, R. T. Burnett, M.J. Thun, E.E. Calle, D. Krewski, K. Ito, and G.D. Thurston. 2002. Lung Cancer, Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution. Journal of the American Medical Association 287:1132-1141; Pope, C.A., III, R.T. Burnett, G.D. Thurston, M.J. Thun, E.E. Calle, D. Krewski, and J.J. Godleski. 2004. Cardiovascular Mortality and Long-term Exposure to Particulate Air Pollution. Circulation 109:71-77; Pope, C.A. III, E. Majid, D. Dockery. 2009. Fine Particle Air Pollution and Life Expectancy in the United States. New England Journal of Medicine 360:376-386; Pope, C.A. III, M.J. Thun, M.M. Namboodiri, D.W. Dockery, J.S. Evans, F.E. Speizer, and C.W. Heath, Jr. 1995. Particulate Air Pollution as a Predictor of Mortality in a Prospective Study of U.S. Adults. American Journal of Respiratory Critical Care Medicine 151:669-674; and Pope, C.A. III, D.W. Dockery, J.D. Spengler, and M.E. Raizenne. 1991. Respiratory Health and PM_{10} Pollution: A Daily Time Series Analysis. American Review of Respiratory Diseases 144:668-674.

[29] See Laden, F., J. Schwartz, F.E. Speizer, and D.W. Dockery. 2006. Reduction in Fine Particulate Air Pollution and Mortality. American Journal of Respiratory and Critical Care Medicine 173:667-672.

[30] Michelle L. Bell, Aidan McDermott, Scott L. Zeger, Jonathan M. Samet, Francesca Dominici (2004) "Ozone and Short Term

and the high range uses the 2006 Laden Study for $PM_{2.5}$ mortality and Levy[31] for ground level ozone. EPA did two things to address the overall uncertainty in the analysis: (1) it performed analysis using the widely accepted Monte Carlo method for "characterizing random sampling error associated with the concentration response functions from epidemiological studies and economic valuation function;"[32] and (2) it utilized an expert elicitation on the relationship between premature mortality and ambient $PM_{2.5}$ concentration.[33] Since issuing the CAIR RIA in 2005, EPA adopted the following technical enhancements in this RIA of the Toxics Rule:

1. The Toxics Rule RIA supplements CAIR's analysis, which quantified PM-related mortality using the C-R function from the 2002 Pope Study, with the 2006 Laden Study's C-R function estimate. Thus, the EPA presents two core $PM_{2.5}$ estimates; one based on the Pope Study and the second based on the Laden Study.

2. The Toxics Rule RIA also includes the twelve $PM_{2.5}$-mortality estimates based on EPA's expert elicitation study used in the CAIR study, and

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Mortality in 95 US Urban Communities, 1987-2000". Journal of American Medical Assoc. 292, 2372-2378.

[31] Levy JI, Chemerynski SM, Sarnat JA. July 2005. Ozone Exposure and Mortality: an Empiric Bayes Metaregression Analysis, Epidemiology 14(4):458-68.

[32] RIA at page 6.2.

[33] RIA at page 6.2.

presents "$PM_{2.5}$-related premature mortalities avoided drawn from the expert elicitation."[34]

[Page 25]

As SO_x and NO_x emissions increase, $PM_{2.5}$ concentrations in the air also increase and, as NO_x emissions rise, ozone concentrations in the air also increase. Based on the widely accepted C-R method, peer-reviewed scientific evidence finds conclusively, with great statistical confidence, that higher concentrations in the air of these hazardous substances increase the incidence of premature mortality. Numerous variables in the proven C-R model remove confounding factors and purge missing variable bias. EPA's two state-of-the-science approaches considered a wide range of variables in a complex sensitivity analysis to estimate the likely range of premature deaths. Table 3 below, which reproduces EPA's Table 6-4 in the RIA,[35] describes EPA's comprehensive and robust approach. For example, EPA prefers to use the most recent peer-reviewed research available, and prefers cohort studies that, unlike ecological studies, can be controlled for important confounding variables. EPA quite reasonably prefers using domestic, multi-city studies covering the broadest population to best ascertain total national level health impacts.

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[34] RIA at page 6-22.

[35] RIA at 6-18.

[Page 26] TABLE 3 Table 6-4. Criteria Used when Selecting C-R functions

Consideration	*Comments*
Peer-Reviewed Research	Peer-reviewed research is preferred to research that has not undergone the peer-review process.
Study Type	Among studies that consider chronic exposure (e.g. over a year or longer) prospective cohort studies are preferred over ecological studies because they control for important individual-level confounding variables that cannot be controlled for in ecological studies.
Study Period	Studies examining a relatively longer period of time (and therefore having more data) are preferred, because they have greater statistical power to detect effects. More recent studies are also preferred because of possible changes in pollution mixes, medical care, and lifestyle over time. However, when there are only a few studies available, studies from all years will be included.
Population Attributes	The most technically appropriate measures of benefits would be based on impact functions that cover the entire sensitive population but allow for heterogeneity across age or other relevant demographic factors. In the absence of effect estimates specific to age, sex, preexisitng condition status, or other relevant factors, it may be appropriate to select effect estimates that cover the broadest population to match with he desired outcome of the analysis, which is total national-level health impacts. When available, multi-city studies are preferred to single city studies because they provide a more generalizable representation of the C-R function.
Study Size	Studies examining a relatively large sample are preferred because they generally have more power to detect small magnitude effects. A large sample can be obtained in several ways, either through a large population or through repeated observations on a smaller population (e.g. through a symptom diary recorded for a panel of asthmatic children).
Study Location	U.S. studies are more desirable than non-U.S. studies because of potential differences in pollution characteristics, exposure patterns, medical care system, population behavior, and lifestyle.
Pollutants Included in Model	When modeling the effects of ozone and PM (or other pollutant combinations) jointly, it is important to use properly specified impact functions that include both pollutants. Using single-pollutant models in cases where both pollutants are expected to affect a health outcome can lead to double-counting when pollutants are correlated.
Measure of PM	For this analysis, impact functions based on PM2.5 are preferred to PM10 because of the focus on reducing emissions of PM2.5 precursors, and because air quality modeling was conducted for this size fraction of PM. When PM2.5 functions are not available, PM10 functions are used as surrogates, recognizing that there will be potential downward (upward) biases if the fine fraction of PM10 is more (less) toxic than the coarse fraction.
Economically Valuable Health Effects	Some health effects, such as forced expiratory volume and other technical measurements of lung functions, are difficult to value in monetary terms. These health effects are not quantified in this analysis.
Non-overlapping Endpoints	Although the benefits associated with each individual health endpoint may be analyzed separately, care must be exercised in selecting health endpoints to include in the overall benefits analysis because of the possibility of double-counting of benefits.

EPA scientifically estimated the range of premature deaths from $PM_{2.5}$ and ozone using

[Page 27]
"with and without" comparisons that effectively shift the C-R function for air emissions under the Toxics Rule from the assumed baseline that conservatively presumes full Transport Rule compliance. Based on the expected shift under the Toxics Rule from the Transport Rule's baseline in C-R, the midpoint of the range of 6,800 to 17,000 deaths is 11,900 premature deaths per year. Using the midpoint of 11,900 avoided premature deaths per year and a $7.8 million per death VSL, the Toxics Rule annual health benefits alone would equal $92.8 billion per year. Compared to direct incremental annual compliance costs of about $10.9 billion per year to that midpoint benefits amount, for just avoided premature deaths, Toxics Rule net benefits would exceed costs by about $81.9 billion per year. Therefore, the reduction in mercury and heavy metal HAPs can be achieved with no net costs because the conservatively estimated compliance costs have been paid for with the additional annual savings that are about 8.5 times greater than the Toxics Rule compliance costs. The peer-reviewed and scientifically estimated values and methods EPA used in the Toxics Rule RIA unequivocally demonstrate the Toxics Rule's expected benefits far exceed estimated costs.

3. Other Reasons Why EPA's Net Benefit Analysis is Very Conservative

Additional reasons for concluding that EPA's Toxics Rule RIA net benefit analysis is very

conservative and likely understates net benefits include: (1) it understates the serious effects for at-risk populations; (2) it has comprehensively identified and fully accounted for possible uncertainties; (3) it does not account for *all* benefits and, therefore, understates benefits; (4) it overstates estimated compliance costs; and (5) it underestimates the energy efficiency and demand-side management potential.

(i) At-Risk Populations

EPA reasonably did not attempt to monetize the benefits from avoiding the release of poisonous and carcinogenic HAPs because there has been less comprehensive peer review of these matters. Furthermore, the undisputed benefits, including opportunity benefits, necessary

[Page 28]
for the least-cost test significantly exceed compliance costs. Instead of introducing less than fully vetted analyses, EPA used an example of the monetized benefits related to avoiding the IQ losses for exposed populations that self-catch fish. These effects are worth considering because they demonstrate the difference between the release of HAPs into the environment and their directly observable pathways to at-risk individuals.

There is a stark difference between mothers eating mercury-laden fish and how this affects their children in utero. These pathways are direct and have very high probability of severe harm. In contrast, many major airborne pollutants, such as particulates, have lower probability consequences,

causing lung disease for a small percentage spread across a large population of exposed individuals. Toxics tend to harm smaller concentrated populations with a high probability of severe harm. This raises the risk avoidance aspect of this source of pollution. EPA's RIA analyses did not need to quantify this risk effect because the benefits that EPA monetized easily exceed the compliance costs. Regardless, the risk and damage for the exposed individuals from HAPs exposure is all too real and very severe.

(ii) Comprehensive Identification of Uncertainties

EPA performed a careful and comprehensive review of the uncertainties inherent in all net benefit analyses. EPA recognized that there are limitations in its ability to model the health damages caused by power plant emissions and to quantify the benefits of emission reductions. As for the implications of these uncertainties, EPA noted: "There are costs and important benefits that EPA could not monetize, such as those for the HAP being reduced by this proposed rule other than mercury. Upon considering these limitations and uncertainties, it remains clear the benefits of the proposed Toxics Rule are substantial and far outweigh the costs."[36] The

[Page 29]
transparency of EPA's exhaustive discussion of uncertainties, as detailed below in Table 4, and resulting quantitative omission of some benefits,

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[36] RIA at page 1-1.

represents the best in scientific methods and underscores that EPA benefits are likely understated. More to the point, this rule would reduce poisons, including many persistent bio-accumulating poisons, in the environment, and the goal should be how to do that cost effectively (*i.e.* the least costs test). This is not the same as insisting monetized benefits must exceed costs (*i.e.* the net benefit test). Regardless, when taking into account direct benefits, including opportunity benefits, the total easily surpasses the conservatively estimated compliance costs, so that the proposed Rule meets the net benefits test as well as the least cost test. Both public policy and economic principles strongly show that EPA has correctly performed the RIA, and the Toxics Rule should be implemented sooner rather than delayed.

TABLE 4

Table 6-3. Primary Sources of Uncertainty in the Benefits Analysis

1. Uncertainties Associated with Impact Functions – The value of the ozone or PM effect estimate in each impact function – Application of a single impact function to pollutant changes and populations in all locations. – Similarity of future-year impact functions to current impact functions. – Correct functional form of each impact function. – Extrapolation of effect estimates beyond the range of ozone or PM concentration observed in the source epidemiological study. – Application of impact functions only to those subpopulations matching the original study population.
2 Uncertainties Associated with CAMx-Modeled Ozone and PM Concentrations – Responsiveness of the models to changes in precursor emissions from the control policy. – Projections of future levels of precursor emissions, especially ammonia and crustal materials. – Lack of ozone and $PM_{2.5}$ monitors in all rural areas requires extrapolation of observed ozone date from urban to rural areas.
3 Uncertainties Associated with PM Mortality Risk – Limited scientific literature supporting a direct biological mechanism for observed epidemiological evidence. – Direct causal agents within the complex mixture of PM have not been identified. – The extent to which adverse health effects are associated with low-level exposures that occur many times of the year versus peak exposures. – The extent to which effects reported in the long-term exposure studies are associated with historically higher levels of PM rather than the levels occurring during the period of study. – Reliability of the $PM_{2.5}$ monitoring data in reflecting actual $PM_{2.5}$ exposures.
4 Uncertainties Associated with Possible Lagged Effects – The portion of the PM-related long-term exposure mortality effects associate with changes in annual PM levels that would occur in a single year is uncertain as well as the portion that might occur in subsequent years.
5 Uncertainties Associated with Baseline Incidence Rates – Some baseline incidence rates are not location specific (e.g. those taken from studies) and therefore may not accurately represent the actual location-specific rates. – Current baseline incidence rates may not approximate well baseline incidence rates in 2014. – Projected population and demographics may not represent well future-year population and demographics.
6 Uncertainties Associated with Economic Valuation – Unit dollar values associated with health and welfare endpoints are only estimates of mean WTP and therefore have uncertainty surrounding them. – Mean WTP (in constant dollars) for each type of risk reduction may differ from current estimates because of differences in income or other factors.
7 Uncertainties Associated with Aggregation of Monetized Benefits – Health and welfare benefits estimates are limited other available impact functions. Thus, unquantified and unmonetized benefits are not included.
Source: RIA at 6-15

(iii) EPA Has Understated Benefits by Excluding Certain Non- Health Related Benefits.

[Page 31]

EPA's RIA is also very conservative because its co-benefits analysis focused almost exclusively on the health-related benefits of protecting the population from the adverse effects of ground level ozone and $PM_{2.5}$, and did not include welfare-related benefits. EPA's RIA attributed more than 90% of the estimated co-benefits to premature deaths. Decreased sickness, health costs, and morbidity were relatively important components of the remaining ten percent of EPA's co-benefits estimates. Yet even when limiting Toxics Rule co-benefits to the healthrelated ones noted above, EPA found Toxics Rule co-benefits exceed social costs by at least 5 to 1.[37]

Given these staggering health benefits, EPA had little scientific reason to look beyond mortality and morbidity. Although EPA states that it thinks the benefits are substantial, it does not quantify the overall value associated with HAP reductions arising from increased agricultural crop and commercial forest yields, visibility improvements, and reductions in nitrogen and acid deposition and the resulting changes in ecosystem functions.[38] It also fails to account for the costs associated with behavior to

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[37] See RIA, page 1-1, Chapter 1 (Key Findings), where the EPA says "The benefits outweigh costs by about 5 to 1 or 13 to 1 depending on the benefit estimate and discount rate used." See also Table 1-1 on page 1-2.

[38] RIA at page 1-8. See also Table 1-4 on pages 1-9 through 1-10.

avoid the adverse health effects of HAP emissions. For example, many young women forego the pleasures and health benefits of eating the fish subject to mercury advisories by avoiding them, and the costs of this avoidance behavior is not captured in the cost benefit analysis. As EPA explained in the RIA, substantial quantitative benefit omissions or underestimates include:

(1) Enhanced *Ecosystem Services,*[39] which include use and non-use values individuals and organizations derive from ecosystems.

[Page 32]

(2) *Ecosystem Benefits of Reduced Nitrogen and Sulfur Deposition,*[40] which include reducing acidification that can negatively affect both terrestrial and aquatic ecosystems.

(3) Reduced *Ecological Effects Associated with Gaseous Sulfur Dioxide,*[41] which are damages avoided for animal and plant life due to alterations in biogeochemistry. The Eastern United States is particularly sensitive to air-borne related losses in this category, including, for example, acidification of lakes due to transformation of SO_2 to sulfuric acid.

(4) *Nitrogen Enrichment*[42], which includes eutrophication in estuaries. Eutrophication includes low dissolved oxygen levels in water that causes

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[39] RIA at page 6-57.

[40] RIA at page 6-59.

[41] RIA at page 6-68.

[42] RIA at page 6-69.

stress to fish and shellfish, loss of submerged aquatic vegetation, harmful algal blooms, and low water clarity.

(5) *Benefits of Reducing Ozone effects on Vegetation and Ecosystems,*[43] which includes increasing the diversity, health, and vigor of various species.

(6) *Unquantified SO2 and NO2-Related Human Health Benefits,*[44] which include primarily respiratory effects that result in increased hospital and emergency room visits, respiratory symptoms, airway hyper-responsiveness, airway inflammation, and lung function.

One of the reasons for these omissions could be the same level of scientific advisory review has not been completed for the various HAPs as have been completed for SO2, NO_x and PM2.5. As in the case of the other benefits that EPA did not quantify in its RIA, the additional time and cost associated with the additional quantification would only have gilded the lily. Incurring this

[Page 33]
additional delay and cost when the benefits have already been clearly demonstrated would not have met either the least cost or net benefit test.

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[43] RIA at page 6-71.

[44] RIA at page 6-78.

(iv) Overestimation of Compliance Costs

Fairly consistently, previous estimates of various environmental compliance costs have been substantially lower than originally projected. M.J. Bradley Associates reported that SO_2 and VOC emission *ex ante* compliance cost estimates significantly overestimated costs.[45] In the case of the Toxics Rule, EPA determined estimated compliance costs using the widely endorsed Integrated Planning Model (IPM), but acknowledges that its estimated costs may well be too high. Specifically, as the EPA concedes, its IPM analysis of the Toxics Rule does not take into account the "potential for advancements in the capabilities of pollution control technologies for SO_2 and NO_x removal, as well as reductions in their costs over time."[46] The EPA explained that cost estimates for the Clean Air Act Title IV acid rain SO_2 program made by Resources for the Future and MIT could be as much as 83% lower than EPA's original projections, which were made using "an optimization model like IPM." *Ex ante*, EPA's acid rain cost estimates were $2.7 to $6.2 billion, whereas *ex post* these costs were estimated to be only $1.0 to $1.4 billion.[47]

There are two very important additional reasons why the IPM compliance cost estimates very likely

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[45] Van Atten, C and L. Hoffman-Andrews of M. J. Bradley Associates, "The Clean Air Act's Economic Benefits Past Present and Future, Small Business Majority and The Main Street Alliance, October 2010, p.7.

[46] RIA at page 8-32.

[47] RIA at page 8-33, using a comparison of $1 billion to $6.2 billion.

are too high. First, the electricity industry has an uninterrupted, successful history of implementing technical improvements and reducing costs through least cost engineering principles. Numerous entities in the power sector will be focused on reducing costs and achieving savings through fuel switching, enhanced generation utilization and accelerated use of more efficient, state-of-the-art equipment. Second, EPA likely over-estimated costs because it

[Page 34]
failed to quantify the effect of reasonably anticipated accelerated supply side and demand side responses.

Generators maintain, retire, or replace power plants based on a combination of engineering and economic factors and analyses. This can cause new coal units to replace older coal units sooner. Older coal-fired units have higher heat rates, typically in the range of 11,500 to 12,000, than new coal fired generation with heat rates less than 10,500.[48] The more than ten percent improvement in heat rate efficiency improvement means replacement coal-fired generation will use less coal and emit less air pollution. The gains from new natural gas-fired generation replacing older coal-fired generation are even more significant. For example, new natural gas combined-cycle electricity generating units typically

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[48] For example, the 695 MW coal-fired Longview Power Plant that opened in West Virginia in May 2011 has a heat rate of approximately 8800. [NB the permit sets a maximum heat input of 6114 MMBTU and states that the consent order gives a capacity of 600 MW, while the announcement states 695 MW – this uses the 695]

have heat rates of less than 7,000[49] and they emit only about 25 percent of the NO_x per MWH generated than coal.[50] EPA's RIA makes very conservative assumptions related to both greater efficiency and less emissions.

A new pollution rule such as the Toxics Rule alters the relative costs and prices throughout the electric power industry. Although models such as IPM can broadly estimate response costs, retirements, replacements and reliability requirements, in actual real world engineering, the many smaller "parts" of the industry will seek their own customized engineering and economic responses. The sum of these many smaller parts will, therefore, invariably achieve lower overall response costs than a model such as IPM might estimate for the power sector as a whole. Thus, the IPM model conservatively favors the *status quo*. This fact is well known, transparent, and has been thoroughly vetted. This is not a criticism of the IPM estimates, but

[Page 35]
further confirms that Toxics Rule benefits will likely exceed costs by significantly more than the ratios calculated both by EPA and in this Report.

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[49] For example, GE Power System has 11 models of combined cycle turbines with heart rates below 7,000. Four of those models have heat rates below 6,000. See GE Power Systems; Gas Turbine and Combined Cycle Products.

[50] The EPA reports that the average coal-fired generating plant in the US produces 6 lbs of NOx per MWH, while a natural gas fired generating plant produces only 1.7 lbs of NOx per MWH.

Compared to older coal-burning units and with production costs of about $3 per MCF, shale gas represents a cost effective fuel that will support new, cost-effective electric generation with very significant improvements in air quality and GHG reductions. Although the IPM model did include the effect of the stabilization of natural gas prices arising from the shale gas boom, it does not adequately capture the opportunities for new structural shifts in the electricity generation industry. Some of the most productive shale gas areas are located where many of the antiquated coal-fired plants will retire.

Pennsylvania, which formerly referred to itself as the Saudi Arabia of coal, now refers to itself as the Saudi Arabia of gas. This presents the opportunity for new development and finance models. For example, many gas wells are "shut-ins" with no immediate access to natural gas pipelines. Many older coal plants have existing transmission lines but no access to natural gas pipelines. This raises the possibility of supplying new combined cycle plants with unregulated gathering lines, using the new unexploited resource and the existing transmission infrastructure, water supply, and pollution offsets from closing the coal plants. Up to nine coal-fired plants that are located in Pennsylvania, Ohio, West Virginia, and New York and projected by the RIA to retire as a result of the Toxics Rule are located above the Marcellus Shale Gas Formation, the Utica Shale Gas Formation, or both. The IPM model does not

capture these types of entrepreneurial opportunities.[51]

(v) EPA has Overstated Costs by Not Including Energy Efficiency and Demand Response in its Analysis

[Page 36]

The nation's electric and natural gas sectors are increasingly supporting new end-use customer investments in demand response, distributed and centralized renewable energy, and energy efficiency. Nationwide, the electricity industry is approaching $5 billion in annual spending on utility-sponsored demand response programs and natural gas distributors are spending nearly $1 billion each year to encourage consumers to conserve natural gas. A recent American Gas Association survey[52] of natural gas utilities reported a 46.7% increase in conservation expenditures between actual expenditures for 2008 and budgeted expenditures for 2009.

The electricity sector has been increasing electricity-related energy efficiency and demand response spending as well. The U.S. Department of Energy's Energy Information Administration (EIA) reports a similar 47% increase between 2007 and

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[51] As noted below, the existence of fully depreciated coal plants operating with few or no controls also likely inhibits new development projects by depressing capacity and electricity markets alike.

[52] AGA "Natural Gas Efficiency Report 2008 Program Year", Appendix B.

2008.[53] The planned and actual expansions of the "smart grid" also will likely lead to greater end use efficiencies and more load management. Additionally, expanding the use of distributed and centralized renewable energy to replace some older, less efficient fossil-fired, particularly coal-based generation, may lower compliance costs. These efforts to become more efficient on both sides of the meter will combine to further reduce the likely compliance costs related to the Toxics Rule.

EPA recognized energy efficiency investments and demand response could reduce compliance costs for EGUs. EPA also explained its "modeling does not typically incorporate a 'demand response' in its electric generation modeling (Chapter 8)..." Therefore, in the RIA EPA assumed a constant demand.[54] Nevertheless, the EPA did develop "an end-use energy efficiency policy scenario and analyzed the associated effects."[55] This sensitivity analysis was based on the

[Page 37]
federal government implementing federal appliance standards and an increase in ratepayerfunded energy efficiency programs.[56]

EPA's Energy Efficiency Sensitivity Scenario resulted in less incremental compliance costs for the Toxics Rule. EPA found the overall reduction in

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[53] EIA Form 861.

[54] RIA page 7-18.

[55] RIA page 8-27.

[56] RIA page 8-27.

annual electricity system compliance costs would be $2.3 billion in 2015, $6.0 billion in 2020, and $11.4 billion in 2030.[57] EPA seemingly apologized for including this energy efficiency analysis when explaining "a possible alternative future where use of energy efficiency policies lead to increased investment in cost-effective energy end-use technologies beyond what is reflected in the reference electricity demand forecast used for EPA's core analysis."[58] The EPA conservatively did not include these potential energy efficiency costs as an offset to annual compliance costs. Furthermore, EPA's assumed level of energy efficiency does not reflect the full implementation of all technical and economic energy efficiency that others have shown to be achievable energy efficiency targets.[59] The EPA admits that its "projected reductions in demand growth are substantially lower than recent estimates of available, cost effective energy efficiency potential."[60]

The results of the most recent PJM capacity auction, which include consideration of the likely impact of the Air Toxics Rule, confirm that cost effective energy efficiency will reduce compliance

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[57] RIA page 8-28. See also Table 8-16, page 8-29.

[58] RIA page 8-27.

[59] See for example, Cicchetti, Charles J., Going Green and Getting Regulation Right: A Primer for Energy Efficiency. Public Utilities Reports, Inc. Vienna, VA 2009. See also Real Prospects for Energy Efficiency in the United States, National Academy of Sciences, National Academy of Engineering, National Research Council of the National Academies. The National Academies Press, Washington, D.C. 2010.

[60] RIA at page 8-28.

costs, even without the additional state measures suggested by EPA. While 6.9 GW of ancient coal-fired capacity was either withdrawn from the market or failed to clear the auction,

[Page 38]
an additional 4.836 GW of demand response resources cleared the auction, mitigating impacts on consumer prices. [61]

The conclusion is clear. Many changes have already been made in the electricity industry to reduce demand and harmful emissions and improve efficiency on both sides of the meters. The natural gas and shale gas boom occurring across the nation also makes it likely that EPA overstates the compliance costs for the Toxics Rule. Accordingly, the actual compliance cost for implementing the Toxics Rule will very likely be less and the expected benefits far greater than EPA has estimated in the RIA.

Section II. The Toxics Rule Stimulates Employment, Businesses, and Government Receipts

EPA's analysis shows that the benefits from implementing the Toxics Rule far outweigh the costs even though EPA did not monetize several benefits of the Rule. This section quantifies some additional benefits related to employment, businesses, and governments that will arise from the Toxics Rule's

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[61] Ade Dosunmu, *Up in Smoke*, Fortnightly's Spark (June 29, 2011), *available at* http://spark.fortnightly.com/sitepages/pid58.php?ltemplate=intro_archive&pageId=58&lcommtypeid=6&item_id=3 0.

implementation. The findings here further reinforce that the Toxics Rule will strengthen, not weaken, the economy and add jobs and that the Toxics Rule should be implemented without delay.

As further developed below, some additional benefits that EPA did not quantify include:

(i) Avoided lost work days and labor cost savings;

(ii) Reduced health and insurance costs; and,

(iii) Increased employment at a time when the economy is depressed.

[Page 39]

A. Lost Work Days and Labor Costs

EPA estimates the number of lost work days due to $PM_{2.5}$ and ground level ozone emissions under both baseline conditions and the Toxics Rule, calculating that workers 18 to 65 years of age annually lose 850,000 work days across all states. EPA further estimates the economic effect of lost work for average workers using a value for their time of about $130 per day[62] for an annual total of $110,500,000. Notably, however, EPA measures losses only from the perspective of employees. However, employers *also* incur losses as they typically pay for sick days and other benefits in addition to wages for each

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[62] RIA at page 6-47, Table 6-11. As this is based on a national median wage of $16.25 hourly for 2000, it is a very conservative estimate.

employee.[63] For example, the Bureau of Labor Statistics reported in June 2010 that total compensation comprised 70.6% for wages and salaries and 29.4% for benefits, with the combined civilian workforce total compensation averaging $29.52 per hour (or $236 per 8 hour day), state and local government workers averaging $39.74 per hour, and private sector workers averaging $27.64 per hour. [64]

Beyond paying employees sick leave and related payroll taxes and benefits, employers incur additional costs due to lost productivity. For example, personnel discontinuity, required replacement workers and temporary staff, redundant training, and missed or postponed opportunity costs, all impose higher costs on businesses. In the spring of 2010, Mercer Consulting[65] surveyed 276 organizations from all major U.S. industry segments, sizes, and regions, including colleges and universities; health care; hospitality; manufacturing, life sciences, and energy; public sector, government and public schools; retail or wholesale trade, services; and transportation, distribution, and telecommunications. The Mercer study estimated that

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[63] "Survey on the Total Financial Impact of Employee Absences", Mercer and Kronos Incorporated, June 2010.

[64] BLS News Release, September 8, 2010, USDL-10-1241.

[65] Mercer Consulting is a leading consultancy in Human Resources (HR) and related financial products and services. It is a wholly owned subsidiary of Marsh & McLennan Companies, Inc. and has more than 19,000 employees worldwide in over 180 cities and 40 countries and territories. See www.mercer.com/about-mercer.

[Page 40]
unplanned absences reduce productivity by about 19%[66], meaning civilian business and government employers would, on average, lose about $35.13 per hour ($29.52 * 1.19), or about $281 per day for each work loss day. Therefore, under the Toxics Rule, business would avoid losses of $239 million per year (850,000*$281= $239 million per year).

Pre-mature deaths also require businesses to pay more for employee recruiting, training, integration, and replacement. In its median case, EPA estimates conservatively that implementing the Toxics Rule would avoid 11,900 premature annual deaths for ages 18-65. Applying US Census Bureau estimates that 80% of the population is in the work force, 9,520[67] of these premature deaths are in the work force. As the typical person works about 48 five-day weeks, or 240 work days per year, the typical civilian employee's total compensation (wages plus benefits) equals $56,640 (240 days * $236/day). Various estimates show the cost to replace an employee is

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[66] Mercer, "Survey of the Total Financial Impact of Employee Absences", June 2010, page 8.

[67] The U.S. Census Bureau reports that there were approximately 189 million people between the age of 18 and 65 in the U.S. There were approximately 153 million people in the workforce, or about 80% of the population. 11,900 times 80% equals 9,520. See 2006-2008 American Community Service Survey 3-Year Estimate. U.S. Census Bureau. http://factfinder.census.gov.servlet/SSTable. Accessed 9/22/2010

about 40%[68] of total compensation ($56,640), or about $22,650 (0.40 * $56,640)

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[68] Ostro, Bart D. "The Effects of Air Pollution on Work Loss and Morbidity." Journal of Environmental Economics and Management 10, 371-382 (1983); Ostro, Bard D. and Susy Rothschild. "Air Pollution and Acute Respiratory Morbidity: An Observational Study of Multiple Pollutants." Environmental Research 50, 238-247 (1989); Ostro, Bart D. "Air Pollution and Morbidity Revisited: A Specification Test." Journal of Environmental Economics and Management 14, 87-98 (1987); Rumsberger, Jill S., Christopher S. Hollenbeak, and David Kline, "Potential Costs and Benefits of Smoking Cessation: An Overview of the Approach to State Specific Analysis." Penn State. April 30, 2010; Hayday, Beban S., "Costing Sickness Absence in the UK." Institute for Employment Studies, Report 382, October 2001; Bureau of Labor Statistics, "Employer Costs for Employee Compensation – June 2010", USDL-10-1241, September 8, 2010; "Estimating Mortality Risk Reduction and Economic Benefits from Controlling Ozone Air Pollution." The National Academies, Committee on Estimating Mortality Risk Reduction Benefits from Decreasing Tropospheric Ozone Exposure, ISBN 0-309-119995-2 (2008); Scitovsky, Anne A., "Estimating the Direct Costs of Illness." The Milbank Memorial Fund Quarterly. Health and Society, Vol. 60, No. 2 (Summer 1982), pp. 463-491; "Full Cost of Employee Absence Equals 36 Percent of Payroll, According to New Mercer Study Sponsored by Kronos." Boston Business Journal, October 21, 2008; Hadzima, Joe. "How Much Does an Employee Cost?" http://web.mit.edu/e-club/hadzima/how-much-does-an-employee-cost.html; U.S. Bureau of Labor Statistics, "Total Nonfatal Occupational Injury and Illness Cases, by Category of Illness, Private Industry, 2006" (October 2007); U.S. Bureau of Labor Statistics, "Number of Injuries and Illnesses with Days Away from Work, Private Industry, 2003-2006" (November 2007); Berk, Aviva, Lynn Paringer, Selma T. Mushkin, "The Economic Cost of Illness, Fiscal 1975." Medical Care, Vol. 16, No. 9 (Sep. 1978), pp 785-790; Cooper, Barbara S. and Dorothy P. Rice, "The Economic Cost of Illness Revisited" Office of Research and Statistics, Social Security Administration

[Page 41]
per replaced worker. Employers would save the cost to recruit, train, integrate, and replace 9,520 workers each year under the Toxics Rule. This would save 9,520 workers, multiplied by $22,650, or about $216 million per year.

Air pollution also causes businesses to lose money through restricted activities for outdoor workers. In the RIA, EPA estimates there are 5,100,000 restricted activity person-days for adult workers in the 18 to 65 year old category based on the statistical work of Ostro and Rothschild [69], which limits lost person days to the outdoor workers likely to be restricted because of air pollution. Reduced activity clearly causes a loss in productivity, but is less severe than losing a full work day. As discussed above, Mercer Consulting estimates that unplanned absences reduce productivity about 19%. Assuming that a restricted worker would function at about half his usual level, a conservative estimate of restricted output equals approximately 484,500 lost days (5,100,000 restricted days * 0.19 loss in productivity * ½ level of effort). This effect of the Toxics Rule will save employers $136 million per year in avoided lost productivity (484,500 lost days * $281/day).

Adapted from a paper presented at the annual American Public Health Association meetings in Chicago, Ill., November 20, 1973 (Bulletin 1976); Abt Associates Inc., Technical Support Document for the Powerplant Impact Estimator Software Tool, prepared for the Clean Air Task Force, July 2010.

[69] Ostro, Bart D. and Susy Rothschild. "Air Pollution and Acute Respiratory Morbidity: An Observational Study of the Multiple Pollutants." Environmental Research 50, 238-247 (1989).

The combined employer business savings for lost workdays, employee recruiting, training, integration, and replacement, and avoided restricted outdoor activities equals about $591 million per year.[70] In addition to the substantial employer benefits resulting from the Toxics Rule, a multiplier effect applies across the national economy. Because of the interconnections among industries and between industries and households, higher costs for wages, benefits, and health insurance cause negative ripple effects throughout the economy. Negative ripple effects result in job loss and reductions in economic outputs because of

[Page 42]
decreased disposable income as fewer workers are hired and fewer wages are paid to employees, as well as reduced equipment and supplies purchased from local businesses, and reduced government tax revenues. These ripple effects are called multipliers effects or multipliers. The Department of Commerce publishes a widely used model to determine the employment and economic effects for increased spending.[71] Applying a multiplier of 1.86, the Toxics

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[70] $239 million + $216 million + $136 million = $591 million.

[71] The U.S. Department of Commerce publishes RIMS II Type I multipliers, which represent the additional indirect or upstream jobs generated for each job directly added in the selected industry. The RIMS II Type II multipliers add incidental jobs within the state due to the additional stimulative economic effect of added direct and indirect/upstream employment or, conversely, eliminate jobs as a result of reduced economic activity. The ripple effect can be thought of in terms of three buckets. For example, consider a manufacturing facility that lays off four workers due to air pollution. The first bucket comprises the four direct

Rule adds about $1.099 billion per year to Gross Domestic Product (GDP). Assuming federal, state and local tax expenditures equal 37.5% of GDP,[72] tax revenues will increase by about $412 million per year. Further, the GDP increase would cause about 8,330 jobs based on 7.58 jobs per million dollars of GDP.[73]

Table 5 summarizes these economic benefits related to labor costs, taxes and jobs under the Toxics Rule. The job and other economic increases reflect the stimulating effects of increased profits due to reduced business costs when less people become sick or die.

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manufacturing jobs at the plant that are lost as a result of air pollution. These four lost jobs and the concomitant reduced manufacturing output at the manufacturing facility have an indirect effect on those upstream industries that support the manufacturing facility. This indirect effect is the second bucket. The indirect effects of reduced manufacturing output downstream result in a loss of two jobs in the support industries upstream of the manufacturing facility. The six total direct and indirect lost jobs due to air pollution mean that the unemployed former employees have less money available to spend. This reduced available money to be spent in the state results in one lost incidental job, comprising the third bucket. Thus, the combined direct (bucket 1), indirect (bucket 2), and incidental (bucket 3) effects result in a total loss of seven jobs.

[72] In 2008, federal, state and local spending were about 37.5% of GDP. "US Governments Spending," Christopher Chantrill, September, 2010. www.usgovernmentsspending.com, link Federal, State and Local for 2008 tax year.

[73] The Department of Commerce's RIMS Type II multipliers range between 5.029 and 10.124 jobs per million dollars of GDP, with a midpoint of 7.58 jobs per million dollars for the 50 states.

[Page 43]

TABLE 5
Economic Benefits Related to Employers' Labor Costs, State and Local Taxes, and Jobs

	All States
Increased GDP	$1.099 billion
Tax Revenues	$412 million
Jobs*	8,330 jobs

*Jobs based on 7.58 jobs per million dollars of GDP.

[Page 44]

Reduced Health and Insurance Costs

The higher levels of pollution increase illnesses. Table 6 shows EPA estimates the air pollution to be eliminated by the Toxics Rule causes more than 380,000 additional illnesses each year at a cost, based on lost income and direct health care costs, of about $3.5 billion per year. These were included in the opportunity benefits that EPA estimated. EPA's estimated medical treatment costs do not reflect the administrative costs that accompany these direct medical treatment costs. A 2003 study in the New England Journal of Medicine estimated these additional costs would add 31% to the direct medical costs.[74]

Applying this to EPA's medical treatment costs would increase the estimated costs for illness from $3.445 billion per year by $1.068 billion to $4.513 billion per year.

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[74] Woolhander, Steffie, M.D., MPH., Terry Campbell, M.H.A., and David U. Himmelstein, M.D. "Costs of Health Care Administration in the United States and Canada.", N. ENGL J. Med 349:8, August 21, 2003.

TABLE 6
EPA's Annual Morbidity Estimates and Costs Within the United States*

Disease	Illnesses	Cost per Year
Chronic Bronchitis	4,500	$2,100,000,000
Non-Fatal Heart Attacks	11,000	$1,200,000,000
Hospital Admissions and Emergency Rooms	12,200	$125,000,000
Other	356,000	$20,000,000
	383,700	**$3,445,000,000**
	Average $8,978 per illness	

*See Tables 6-17 and 6-18 in the Toxics RIA.

[Page 45]

B. Increased Employment from Implementing the Toxics Rule

The University of Massachusetts recently published a report that shows the employment benefits related to a cleaner fleet of power plants in the U.S.[75] This study netted the lost jobs at existing power plants against the jobs related to compliance and replacement. In the RIA, EPA also estimated the direct employment effects of the Toxics Rule. The RIA reasonably combined the net direct effect of jobs lost from retiring coal plants netted against the jobs gained from pollution control investments and pollution control O&M. EPA did not, however, include all the jobs added because it omitted the upstream indirect and incidental job growth that are standard in a benefit-cost analysis. The University of Massachusetts approach can be used to modify the EPA results to add the omitted jobs in the EPA's more conservative analysis.

Starting with construction jobs, EPA estimates 30,870 new jobs. EPA adds 5,230 jobs for the chemicals and materials needed to operate the pollution controls related to the Toxics Rule, and another 5,500 utility jobs for equipment operations and maintenance. The RIA reports that the combined new jobs added equal 41,600. The RIA estimates 5,630 lost jobs associated with retiring coal plants, for a total net number of direct jobs added of 35,970. These are shown in Table 7.

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[75] "Employment Effects Under Planned Changes to the EPA's Air Pollution Rules", University of Massachusetts, Political Economy Research Institute.

TABLE 7
Employment Effects EPA Estimated Due to Pollution Control Equipment and Operations Under the Toxics Rule
(Job Years 2015)

Jobs for Construction	Incremental Employment
1. Boilermakers	13,400
2. Engineers	3,270
3. General construction	13,770
4. Steel Manufacturing	430
Sub Total	30,870
Jobs for Operation (Increased Operating Resource Use)	**Incremental Employment**
1. Limestone	2,020
2. Ammonia	20
3. Catalyst	100
4. Activated Carbon	90
5. Sodium Bicarbonate	2,940
6. Baghouse Material	60
Sub Total	5,230
Jobs for Pollution Control Operation (O&M)	5,500
Total Gains	41,600
Jobs Lost from Plant Retirements	5,630
Net Gains	**35,970**

The U.S. Department of Commerce (USDOC) publishes economic input/output multipliers,[76] which can be used to estimate the additional jobs that result indirectly when

[Page 47]
equipment manufacturers, transportation, and other services that support new investments are counted as well. If EPA had included these indirect jobs as well as the direct net jobs added, the employment effects using a 1.71 Type I multiplier would more accurately equal 61,355. The RIA does not include any explanation of why it did not estimate these indirect jobs added, even though it is standard to add indirect jobs in a benefit-cost analysis. The total net new jobs related to compliance would be 97,325 based on EPA's 35,970 net jobs and 61,355 indirect jobs.

The RIA also did not include the additional jobs as a result of increased spending caused by new direct and indirect jobs. Instead, the EPA's RIA conservatively avers "Moreover, when the economy is at full employment, we would not expect an environmental regulation to have an impact on overall employment because labor is being shifted from one sector to another."[77] This is not a

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[76] The U.S. Department of Commerce publishes RIMS II Type I and II multipliers. The RIM II Type I multipliers add the indirect jobs. The average national Type I multiplier is 1.71 for the electricity industry. The RIMS II Type II multipliers add incidental jobs due to the additional economic effect of added direct and indirect/upstream employment. The RIMS II Type II national average multiplier is 2.98

[77] RIA page 9-6.

reasonable assumption because the national recession has structural problems and likely will last a long time. Furthermore, full employment is not a static goal or even a precise level of employment. The USDOC's Type II comprehensive jobs' multipliers are more accurate indicators of the jobs likely to be added to the economy. Accordingly, starting with the net addition of direct jobs (35,970) added from implementing the Toxics Rule and using the Type II federal multiplier of 2.98, the combined direct, indirect, and incidental jobs added would be about 107,190 or nearly three times the net jobs EPA estimated quite conservatively. Using a rather conservative Mercer Consulting compensation estimate of $56,640 per employee discussed above, the 107,190 jobs added would add personal income and benefits of about $6.071 billion to GDP, improve tax receipts by $2.277 billion, and yield significant net social benefits.

The EPA and other jobs analyses related to clean air compliance do not include the structural effects that the Toxics Rule could have on the economy. These are difficult to

[Page 48]
quantify, but by no means unimportant. For example, shifting to bituminous coal would add jobs if this coal replaces the use of lignite and other sub-bituminous coal. At the least, this effect would seem to be jobs neutral. Other major shifts could add even more jobs. The existence of fully depreciated coal plants operating with few or no controls also inhibit new development projects by depressing capacity and electricity markets alike. This, in turn, inhibits

investment in new, more efficient and less polluting technologies in all sectors of the electric industry. The closure of these inefficient, polluting plants more than 40 years after the Clean Air Act was enacted will spur a new wave of investment that will cause economic growth and improve the efficiency of both the industry and the economy as a whole.

Renewable energy and energy efficiency would add jobs that very likely exceed any job losses if older inefficient generating stations are replaced with more eco-friendly, employmentintensive, supply and demand side investments in the electricity sector. Uprating existing nuclear facilities and efficiency improvements in existing fossil fuel-fired facilities will become cost effective and give us more electricity with no additional pollution. The shale gas stimulation effect of the Toxics Rule would also add new jobs not quantified in EPA's employment analyses related to the Toxics Rule. The evidence is that EPA's pollution enforcement efforts will add, not destroy, jobs in the US economy. The regional gains from adding jobs where unemployment is particularly high would also likely be very favorable under the Toxics Rule implementation and the concomitant shift to shale gas and energy efficiency in the electricity industry.

Section III. Conclusion

EPA's comprehensive and conservative cost/benefit analyses rely upon sound and proven scientific methods and data. The Toxics Rule prevents the release of toxic HAPs that literally

[Page 49]
poison people, other species, and their offspring in utero. The effects are often direct and isolated. The policy goal should be to stop their release at least cost. The Toxics Rule not only does this, but creates value many times the direct costs. Some aver that EPA should delay implementing the Toxics Rule because the economy is currently too weak to absorb the implementation costs without extending the recession. They are wrong for two reasons. First, if anything, EPA's analyses understate the Toxics Rule's benefits and overestimate its costs. In fact, many of the Toxics Rule benefits are not monetized. Further, in focusing almost exclusively on reduced premature death and health related benefits, EPA did not consider the additional business savings, federal, state and local tax receipts, direct spending on health care and insurance, and the creation of almost 115,520 new jobs related to compliance (107,190,) and reduced business costs (8,330).

The RIA shows the least cost for reducing HAPs is negative. The annual compliance costs are about $10.9 billion. However, the opportunity benefits in terms of reduced mortality and morbidity related to $PM_{2.5}$ and lower atmosphere ozone range between $53 billion and $140 billion. In addition, Table 8 shows additional benefits that EPA did not monetize related to business, governments, and additional jobs of more than $8.2 billion in one year. If energy efficiency is relied on at the levels EPA contemplates the compliance costs would be $2.3 billion less in 2015 growing to $6 billion in 2020 and $11.4 billion in 2030. The Toxics Rule will yield considerable net benefits, not societal costs.

[Page 49 cont.]

TABLE 8
Additional Benefits

	Direct Economic	Jobs	Tax Revenue
Increased GDP Related to Labor Cost Savings	$1.099 billion	8,330	$412 million
Annual Savings in Health Case Administrative Costs	$1.068 billion	n/a	n/a
Increased GDP Related to Personal Income and Benefits	$6.071 billion	107,190	$2.277 billion
TOTAL	$8.238 billion	115,520	$2.689 billion

Power plants should not be permitted to use the air stream as a free waste transfer system that pollutes the air for downwind populations, while causing many thousands of premature deaths and illnesses each year, and also causing higher labor and higher health insurance costs, lost jobs, and lost tax revenues. Power plants should not discharge hazardous mercury and heavy metals that bio-accumulate and persist in the food chain. These are poisons that harm people, other species, and their in utero offspring. Some HAPs also cause cancer. A benefit-to-cost comparison is not the essential or even the conceptually correct criteria to use to evaluate policies for avoiding the release of toxic poisons. The primary goal should be to avoid exposure and bio-accumulation at a reasonable least cost. The Toxic Rule addresses this absolute need to control HAPs and the least cost for society is negative under EPA's Toxics Rule.

Ignoring the opportunity benefits, the savings to businesses and government for avoided costs, reduced healthcare, and insurance plus job creation would nearly justify full compliance without adding the direct benefits for the exposed population or the co-benefits that cleaner air above the Transport Rule compliance would achieve. The Nation is seldom offered such a starkly obvious public policy choice as EPA's Toxics Rule.

* * *

EXHIBIT 23

To Comments Of Exelon Corporation On Docket ID No. EPA-HQ-OAR-2009-0234 and Docket ID No.EPA-HQ-OAR-2011-0044 76 Fed. Reg. 24,976 (May 3, 2011)

Environmental Health & Engineering, Inc., "Emissions of Hazardous Air Pollutants from Coal-Fired Power Plants," prepared for American Lung Association, (March 7, 2011) ("EH&E Report")

* * *

[Page 1]

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) will soon propose new limits on hazardous air pollutants released to the atmosphere from coal- and oil-fired power plants. The proposal, known as the "Utility Air Toxics Rule", will set new limits on emissions of hazardous air pollutants, which are defined by Congress as chemical pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive problems or birth defects, and that adversely affect the environment. The new power plant limits are to be based on the emissions performance of the best performing power plants and pollution control systems currently in use. When the rules are in place, this will be the first time that EPA has implemented federal limits on mercury, arsenic, lead, hydrochloric acid,

hydrofluoric acids, dioxins, and other toxic substances from coal-fired power plants.

The American Lung Association commissioned Environmental Health & Engineering, Inc. to prepare a report on public health and environmental impacts of hazardous air pollutant emissions from coal-fired power plants that would be a useful resource for the general public. The major findings of the report are summarized here.

Sources and Emissions

- Over 440 power plants greater than 25 megawatts located in 46 states and Puerto Rico, burn coal to generate electric power (USEPA, 2010a); coal combustion accounts for 45% of electricity produced in the United States (USDOE, 2009a).

- The National Emissions Inventory prepared by EPA indicates that emissions to the atmosphere from coal-fired power plants:

    - contain 84 of the 187 hazardous air pollutant identified by EPA as posing a threat to human health and the environment,

    - release 386,000 tons of hazardous air pollutants annually that account for 40% of all hazardous air pollutant emissions from point sources, more than any other point source category, and

- are the largest point source category of hydrochloric acid, mercury, and arsenic releases to air (USEPA 2007).

- Coal-fired power plants are also a major source of emissions for several criteria air pollutants; including sulfur dioxide, oxides of nitrogen, and particulate matter.

[Page 2]
Toxicity and Impacts on Public Health and the Environment

- Hazardous air pollutants emitted to the atmosphere by coal-fired power plants can cause a wide range of adverse health effects including damage to eyes, skin, and breathing passages; negative effects on the kidneys, lungs, and nervous system; the potential to cause cancer; impairment of neurological function and ability to learn; and pulmonary and cardiovascular disease (USEPA, 1998; USEPA, 2011a; USEPA, 2011b).

- Public health risks associated with exposure to mercury in food and metals in airborne fine particulate matter are among the most notable adverse health and environmental impacts associated with emissions of hazardous air pollutants from coal-fired power plants.

- Coal-fired power plants can be significant contributors to deposition of mercury on soil and water.

    - A study in eastern Ohio reported that coal combustion accounted for 70% of the

mercury present in rainfall (Keeler et al., 2006).

- In the same area, 42% of the mercury in samples of rain collected in the summer was attributed to emissions from a coal-fired power plant located less than a mile away (White et al., 2009).

- Mercury that deposits to the earth's surface from air can make its way into waterways where it is converted by microorganisms into methylmercury, a highly toxic form of mercury (Grandjean 2010).

- EPA has determined that exposure to fine particulate matter is a cause of cardiovascular effects including heart attacks and the associated mortality; is likely a cause of hospital admissions for breathing problems and worsening of existing respiratory illness such as asthma; and is linked to other adverse respiratory, reproductive, developmental, and cancer outcomes (USEPA, 2009a; CASAC 2010).

- Hazardous air pollutants, such as arsenic, beryllium, cadmium, chromium, lead, manganese, nickel, radium, selenium, and other metals, are integral components of fine particulate matter emitted directly from coal-fired power plants.

- The metal content of fine particulate matter has been linked to cardiovascular public health impacts in epidemiological and other studies (e.g. Zanobetti et al., 2009).

[Page 3]

- In a recent population-based health impact assessment, particulate matter emitted directly from coal-fired power plants was estimated to account for an average of $3.7 billion[1] of public health damages each year (NRC, 2010).

- Environmental impacts of power plant hazardous air pollutant emissions include acidification of the environment, bioaccumulation of toxic metals, contamination of rivers, lakes, and oceans, reduced visibility due to haze, and degradation of buildings and culturally important monuments.

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[1] Based on average damages of $9 million per coal-fired power plant determined in an analysis of 406 plants

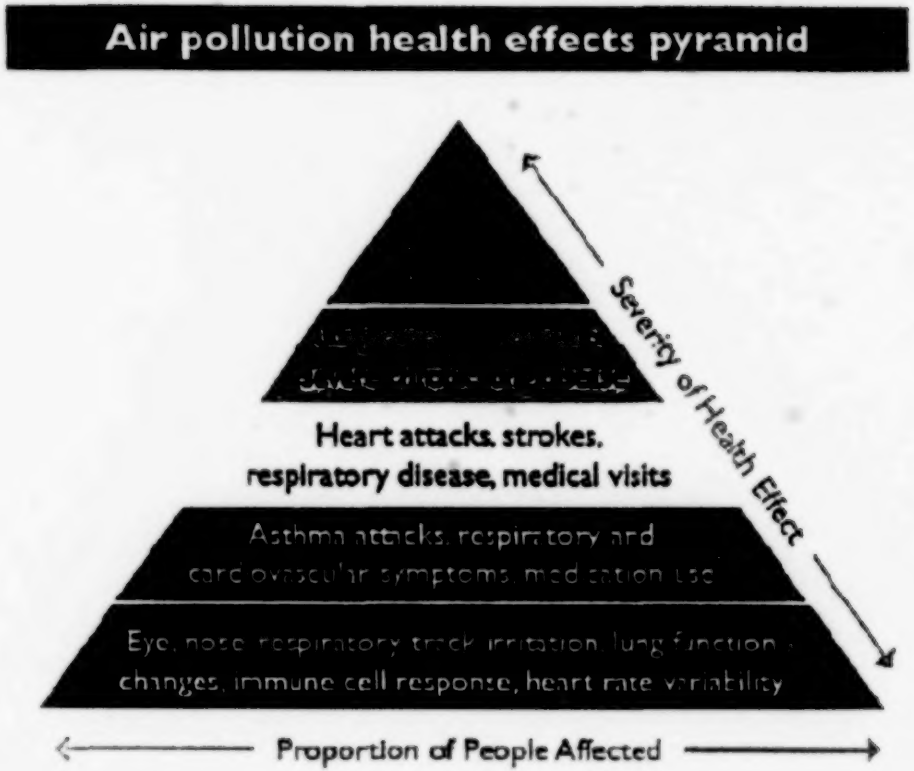

Figure 1. Air Pollution Health Effects Pyramid. Health effects of air pollution are portrayed as a pyramid, with the mildest and most common effects at the bottom of the pyramid, and the more severe but less frequent effects at the top of the pyramid. The pyramid shows that as severity decreases the number of people affected increases. Exposure to air pollution can affect both the respiratory and the cardiac systems. Adapted from USEPA, 2010b.

Transport and Range of Impacts

- Hazardous air pollutants released from coal-fired power plants influence environmental quality and health on local, regional, and global scales.

[Page 4]

- Impacts of certain hazardous air pollutants, including most acid gases and some forms of mercury, appear to impact most heavily on the immediate vicinity of the facility.

- Impacts of non-mercury metals and other persistent hazardous air pollutants released from coalfired power plants are greatest near the source, but can also influence the environment and health far from the source.

    - Analyses of coal-fired power plants have found that public health damages per person were two to five times greater for communities near the facilities than those for populations living at a greater distance from the plants (Levy and Spengler 2002).

    - Analyses conducted by EPA, the National Research Council, and other scientists show that emissions from coal-fired power plants cross state lines and impart public health damages on a regional scale.

Emission Controls for Hazardous Air Pollutants

- Emission rates of hazardous air pollutants vary widely among coal-fired power plants in the

United States, in part because of variation in the use of technologies that can remove pollutants from exhaust gases.

- Hazardous air pollutant emissions from a sample of coal-fired power plants that use multiple modern control technologies were 2 to 5 times lower on average than for a random sample of plants selected by EPA.

- Controls on acid gas and non-mercury metal emissions are likely to reduce emissions of sulfur dioxide and primary particulate matter. As a result, controlling hazardous air pollutant emissions is expected to generate substantial public health and environmental benefits.

- Use of more effective control technologies by more coal-fired power plants as a result of the Utility Air Toxics Rule is expected to reduce the public health and environmental impacts of electricity generated by combustion of coal.

Table 1. Toxicological and Environmental Properties of Hazardous Air Pollutants (HAPs) Emitted from Electric Generating Stations Fueled by Coal

Class of HAP	Notable HAPs	Human Health Hazards	Environmental Hazards
Acid Gases	Hydrogen chloride, Hydrogen fluoride	Irritation to skin, eye, nose, throat, breathing passages.	Acid precipitation, damage to crops and forests.
Dioxins and Furans	2,3,7,8-tetrachlorodioxin (TCDD)	Probable carcinogen: soft-tissue sarcomas, lymphomas, and stomach carcinomas. May cause reproductive and developmental problems, damage to the immune system, and interference with hormones.	Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in the food chain.
Mercury	Methylmercury	Damage to brain, nervous system, kidneys and liver. Causes neurological and developmental birth defects.	Taken up by fish and wildlife. Accumulates in the food chain.
Non-Mercury Metals and Metalloids (excluding radioisotopes)	Arsenic, beryllium, cadmium, chromium nickel, selenium, manganese	Carcinogens: lung, bladder, kidney, skin. May adversely affect nervous, cardiovascular, dermal, respiratory and immune systems.	Accumulates in soil and sediments. Soluble forms may contaminate water systems.
	Lead	Damages the developing nervous system, may adversely affect learning, memory, and behavior. May cause cardiovascular and kidney effects, anemia, and weakness of ankles, wrists and fingers.	Harms plants and wildlife; accumulates in soils and sediments. May adversely affect land and water ecosystems.
Polynuclear Aromatic Hydrocarbons (PAH)	Naphthalene, benzo-a-anthracene, benzo-a-pyrene, benzo-b-fluoranthene, chrysene, dibenzo-a-anthracene	Probable carcinogens. May attach to small particulate matter and deposit in the lungs. May have adverse effects to the liver, kidney, and testes. May damage sperm cells and cause impairment of reproduction.	Exists in the vapor or particulate phase. Accumulates in soil and sediments.

Radioisotopes	Radium	Carcinogen: lung and bone. Bronchopneumonia, anemia, brain abscess.	Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in soils, sediments, and in the food chain.
	Uranium	Carcinogen: lung and lymphatic system. Kidney disease.	
Volatile Organic Compounds	Aromatic hydrocarbons including benzene, toluene, ethylbenzene, xylene	May cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; impaired function of the lungs; delayed response to a visual stimulus; impaired memory; stomach discomfort; and effects to the liver and kidneys. May also cause adverse effects to the nervous system. Benzene is a known carcinogen.	Degrade through chemical reactions in the atmosphere and contribute to carbon-based radicals that contribute to formation of ground-level ozone and its human health effects.
	Aldehydes including formaldehyde	Probable carcinogen: lung and nasopharyngeal cancer. Eye, nose, and throat irritation, respiratory symptoms.	
Hazard information compiled from toxicological profiles and concise chemical assessment documents for specific pollutants published by the Agency for Toxic Substances and Disease Registry and World Health Organization and available on-line (ATSDR, 2011; WHO, 2011).			

[Page 6]

1.0 INTRODUCTION

In accordance with the Clean Air Act, the U.S. Environmental Protection Agency (EPA) will propose new limits on emissions of hazardous air pollutants released to the atmosphere from large power plants that burn coal and oil to generate electricity for sale. EPA will issue the proposed rule by March 16, 2011 as required by a court settlement (US District Court Consent Decree, 2010). The proposal will establish, for the first time, federal limits on emissions of hazardous air pollutants from coal- and oil-fired power plants. Commonly abbreviated as HAPs, hazardous air pollutants are chemical pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive problems or birth defects, and that adversely affect the environment. At this time, EPA has identified 187 chemical pollutants as HAPs (USEPA, 2010c).

Known formally as the National Emission Standards for Hazardous Air Pollutants for Utility Boilers, this rule will apply to all coal- and oil-fired combustion units that generate more than 25 megawatts of electricity. The new limits are to be based on the emissions performance of the maximum available control technology (MACT). According to the Clean Air Act, the MACT standards for existing sources are to be at least as stringent as the average emissions achieved by the best performing 12 percent of existing sources. For new sources, MACT standards are to be at least as stringent as the control level achieved by the best controlled similar source. The set of regulations and impending limits for electric

generating stations is known as the "Utility Air Toxics Rule". Unlike most industry sectors, coal-fired power plants are currently not subject to federal limits on mercury and other HAP emissions.

The American Lung Association commissioned Environmental Health & Engineering, Inc. to prepare this report on HAPs and power plants that generate electricity by burning coal. The report is intended to be a resource for the non-scientific community that summarizes:

- Releases of HAPs to the atmosphere from combustion of coal (i.e., emissions),
- How these substances are transported and where they end up in the environment (i.e., transport and fate),
- Hazards posed by these HAPS and their impacts on human health and the environment (i.e., toxicity and impact), and
- Controls on releases of HAPs and the likely implications of more widespread use on coal-fired power plants (i.e., air pollution control technologies and their benefits).

[Page 7]
2.0 HAZARDOUS SUBSTANCES IN COAL

Coal is a carbon-rich mineral that has been used to generate electricity in this country since the 1800s (NRC 2010). The United States is home to more than a quarter of the world's recoverable coal reserves. In 2008, more than 1 billion tons (2 trillion pounds) of

coal was extracted from the earth at more than 1,600 mining operations throughout the country, approximately half of which was used for electricity generation. The electric energy generated from coal accounts for 45% of all electricity produced in the United States (USDOE, 2009a).

Coal is formed from fossilized plant life that is subjected to pressure and heat over millions of years. As coal is formed, it incorporates substances (impurities) from the surrounding soil and sediment, including sulfur and heavy metals. Some of these impurities consist of hazardous materials such as mercury, arsenic, lead, and nickel. The nature and extent of impurities in any given seam of coal depends on the conditions over the long period during which the coal is formed.

{Figure 2. Coal, in Natural Form – not included}

Ultimately however, coal is classified into one of four types based on its heating value, ash content, and moisture, which in part reflect the extent of impurities present. As shown in Table 2, two types of coal – bituminous and sub-bituminous – account for over 90% of coal use in the country. Pyrite, a mineral rich in iron and sulfur, is a common impurity in bituminous coal, and is a primary host for arsenic and mercury. Sub-bituminous coal contains substantially less sulfur than bituminous coal and is therefore often favored by power plants that desire relatively low emission rates of sulfur dioxide, an important precursor to acid rain and fine particle pollution. Coal is sometimes washed with water and special chemicals to reduce some of the impurities. When burned, the impurities in coal are released and

can be emitted to the atmosphere if not captured by air pollution control equipment operated at the power plant.

The average concentrations of hazardous substances present in various types of coal as reported by EPA are also shown in Table 2. Comparing the two types of coal used predominantly in the U.S.; subbituminous coal contains two to three times lower concentrations than bituminous coal of many substances that become HAPs when emitted from the exhaust stack of a power plant. However, subbituminous coal has a lower heating value than bituminous coal. As a result, more

[Page 8]
sub-bituminous coal than bituminous coal must be burned to produce the same amount of electricity. This means that emissions of mercury and non-mercury HAPs from the two major types of coal can be comparable for a given amount of electricity output even though concentrations of HAPs within the coal types are different.

Table 2. Characteristics of Major Coal Types Used to Generate Electricity in the United States

Characteristic	Anthracite	Bituminous	Sub-bituminous	Lignite
Principal Characteristics[1]				
Percentage of U.S. Production	Less than 0.1%	46.9%	46.3%	6.9%
Heating Value (BTU/lb)	15	11 - 15	8 - 13	4 – 8
Sulfur (%)	Less than 1%	3 – 10%	Less than 1%	Less than 1%
Hazardous Air Pollutants in Coal[2]				
Arsenic	NR	0.5	0.1	0.3
Beryllium	NR	0.11	0.03	0.2
Cadmium	NR	0.03	0.01	0.06
Chlorine	NR	35	2.7	24
Chromium	NR	1.1	0.4	2.2
Lead	NR	0.6	0.2	1.0
Manganese	NR	1.8	1.3	20
Mercury	NR	0.007	0.006	0.03
Nickel	NR	0.9	0.4	1.2

BTU/lb—British Thermal Units per pound of coal; a measure of energy density of coal

NR—Not reported

1—NRC, 2010, Table 2-3.

2—Geometric mean concentration of selected elements in coal; units are pounds per billion BTU (USEPA, 2010a).

[Page 9]

3.0 HAZARDOUS AIR POLLUTANT EMISSIONS

3.1 Emissions

Over 440 power plants in the United States generate electricity for sale by burning coal (USEPA, 2010a). As shown in Figure 3, coal is burned to produce electricity in power plants located throughout the country; with Idaho, Maine, Rhode Island, and Vermont being the only states not to host a coalfired power plant. Coal consumption is concentrated in states of the Midwest and Southeast, although 3 of the top 10 coal consuming plants are located in Texas, near its border with Louisiana and Arkansas. As described in more detail in Section 4.0, HAPs and other pollutants released to the air by coal-fired power plants impact local air quality, but are also carried across state borders and throughout the country by prevailing winds that generally flow from west to east.

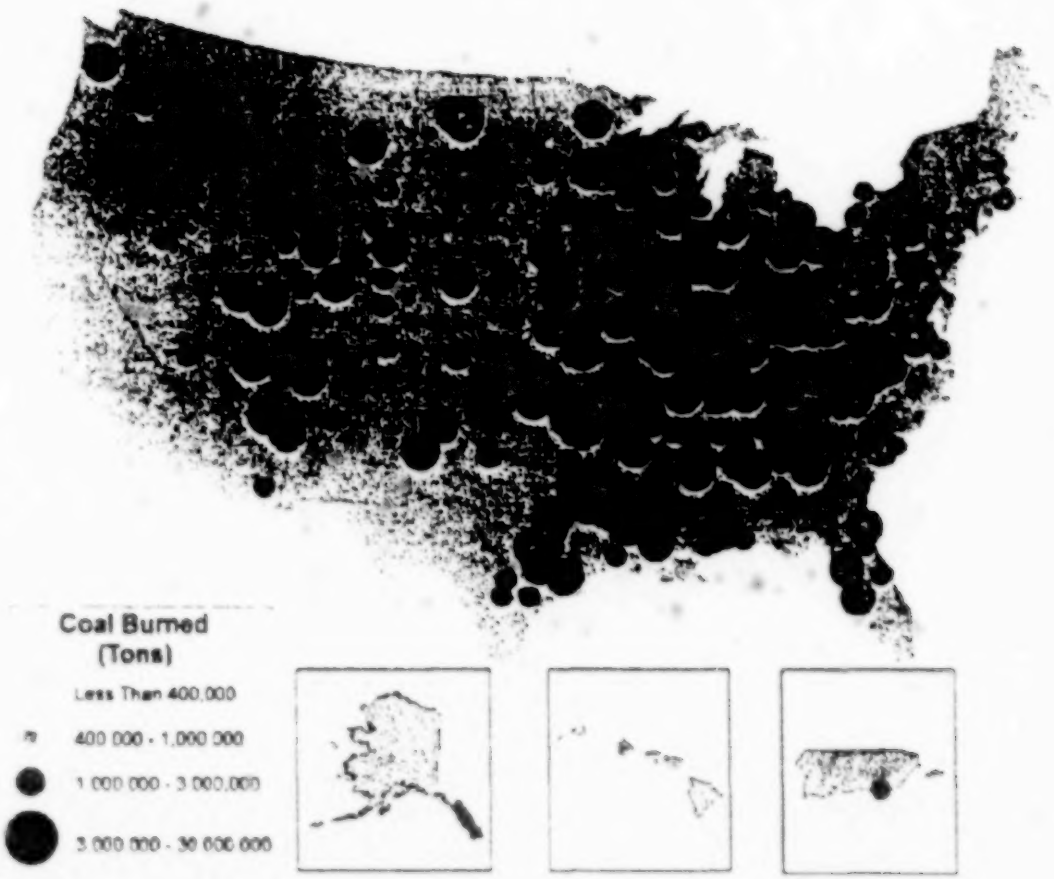

Figure 3. Annual Coal Consumption (tons per year) for Generation of Electricity for Sale by Coal-Fired Power Plants in the United States (USEPA 2010a; USDOE, 2009b). Additional information about the coal consumption of individual power plants is available at www.lungusa.org/ToxicAirReport from the Table of Electric Generating Utility Coal-fired Plants in the U.S.

[Page 10]
Coal-fired power plants emit 84 of the 187 HAPs identified by EPA as posing a threat to human health and the environment (USEPA, 2007). With total emissions of 386,000 tons of HAPs annually, coal-fired power plants account for 40% of all HAP releases from point sources[2] to the atmosphere, more than any other point source category (Figure 4). These emissions include both 'fuel-based pollutants' – e.g., metals,[3] hydrogen chloride, hydrogen fluoride, and mercury – that are a direct result of contaminants in the coal that is combusted; as well as 'combustion-based pollutants' – e.g., dioxins and formaldehyde – which are formed during burning of the coal (USEPA, 2011a).

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[2] The term 'point source' refers to emissions released from a source that is stationary (does not move). Point sources are distinct from sources that can cover a large area, such as a wildfire, and mobile sources such as cars, trucks, and off-road machinery including bulldozers and other earth-moving equipment. Values reported here are based on the latest EPA National Emissions Inventory. EPA is anticipated to publish updated estimates of hazardous air pollutants from coal-fired power plants as part of the Utility Air Toxic Rule.

[3] As in some EPA materials, the class of pollutants referred to for simplicity here as 'metals' includes some elements (e.g. arsenic and selenium) that are not, strictly speaking, fully metallic.

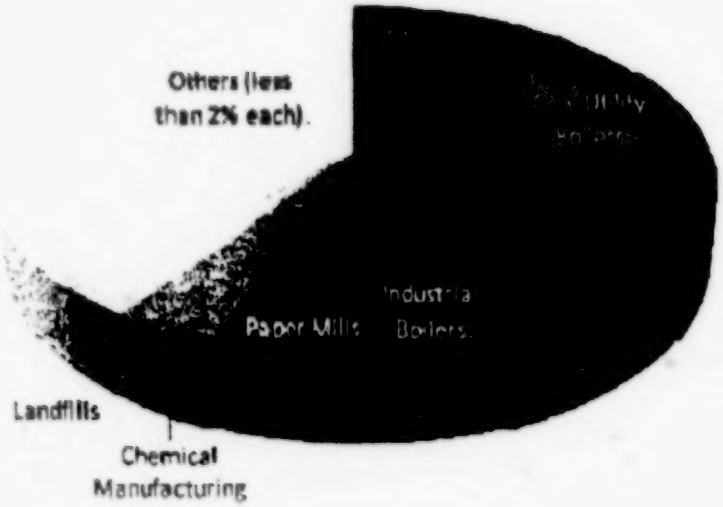


Figure 4 Proportion of Total Hazardous Air Pollutant Emissions From Coal-Fired Power Plants and Other Stationary Sources According to Data in the National Emissions Inventory from the U.S. Environmental Protection Agency (USEPA, 2007).

HAPs emitted from coal-fired power plants include neurotoxins such as mercury and lead, corrosive substances such as hydrochloric acid, carcinogens such as arsenic and benzene, radioactive elements such as radium, and potent organic carbon-based toxins such as dioxins and formaldehyde (USEPA, 2007; USEPA, 2010a). In addition to being the single largest class of total point source HAP emissions, coal-fired power plants are also a major source of emissions for many of these individual HAPs. As shown in Table 3, combustion of coal to generate electricity is the predominant source of hydrochloric acid emissions to the atmosphere (as well as sulfur dioxide and oxides of nitrogen, which are the most

[Page 11]
important sources of atmospheric acidity). Likewise, electricity generating stations powered by coal account for 46% of mercury, and 60% of arsenic released to the atmosphere from point sources.

Table 3. Contributions of Coal-Fired Power Plants to Selected Hazardous Air Pollutant Emissions	
Hazardous Air Pollutant	Percentage of Point Source Emissions
Acid Gases (hydrochloric acid and hydrofluoric acid)	76%
Arsenic	60%
Beryllium	28%
Cadmium	30%
Chromium	20%
Cobalt	34%
Lead	15%
Manganese	11%
Mercury	46%
All Non-Mercury Metal HAPs Emitted by Coal-Fired Power Plants	25%
Data obtained from USEPA, 2007	

3.2 Toxicological Properties

HAPS released to the atmosphere from coal-burning power plants have a wide range of toxicological properties, a summary of which is provided in Table 4. Some of these hazardous air pollutants are released in the form of acid gases, which can cause irritation of and tissue damage to eyes, skin, and breathing passages at high levels of exposure. Long-term exposure to metals has the potential to affect

the kidneys, lungs, and nervous system. Beryllium can cause sensitization reactions that can remain latent for many years then develop into a serious condition called "Chronic Beryllium Disease." Exposure to several of the trace elements, dioxins and furans, polynuclear aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs) in coal-fired power plant emissions increases the risk of cancer. Finally, mercury is a potent neurotoxin, and high accumulation in humans is a cause of brain damage, while lower body burdens are associated with impairment of people's ability to learn and fine motor control, and may be a factor in heart disease. HAPs emitted from coal-fired power plants that have long-term impacts on the environment, such as accumulation in soil, water, and fish, and which can ultimately affect human health are also shown in Table 4.

Table 4. Toxicological and Environmental Properties of Hazardous Air Pollutants (HAPs) Emitted from Electric Generating Stations Fueled by Coal

Class of HAP	Notable HAPs	Human Health Hazards	Environmental Hazards
Acid Gases	Hydrogen chloride, Hydrogen fluoride	Irritation to skin, eye, nose, throat, breathing passages.	Acid precipitation, damage to crops and forests.
Dioxins and Furans	2,3,7,8-tetrachlorodioxin (TCDD)	Probable carcinogen: soft-tissue sarcomas, lymphomas, and stomach cardinomas. May cause reproductive and developmental problems, damage to the immune system, and interference with hormones.	Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in the food chain.
Mercury	Methylmercury	Damage to brain, nervous system, kidneys and liver. Causes neurological and developmental birth defects.	Taken up by fish and wildlife. Accumulates in the food chain.
Non-Mercury Metals and Metalloids (excluding radioisotopes)	Arsenic, beryllium, cadmium, chromium nickel, selenium, manganese	Carcinogens: lung, bladder, kidney, skin. May adversely affect nervous, cardiovascular, dermal, respiratory and immune systems.	Accumulates in soil and sediments. Soluble forms may contaminate water systems.
	Lead	Damages the developing nervous system, may adversely affect learning, memory, and behavior. May cause cardiovascular and kidney effects, anemia, and weakness of ankles, wrists and fingers.	Harms plants and wildlife; accumulates in soils and sediments. May adversely affect land and water ecosystems.

Polynuclear Aromatic Hydrocarbons (PAH)	Naphthalene, benzo-a-anthracene, benzo-a-pyrene, benzo-b-fluoranthene, chrysene, dibenzo-a-anthracene	Probable carcinogens. May attach to small particulate matter and deposit in the lungs. May have adverse effects to the liver, kidney, and testes. May damage sperm cells and cause impairment of reproduction.	Exists in the vapor or particulate phase. Accumulates in soil and sediments.
Radioisotopes	Radium	Carcinogen: lung and bone. Bronchopneumonia, anemia, brain abscess.	Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in soils, sediments, and in the food chain.
	Uranium	Carcinogen: lung and lymphatic system. Kidney disease.	
Volatile Organic Compounds	Aromatic hydrocarbons including benzene, toluene, ethylbenzene, xylene	May cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; impaired function of the lungs; delayed response to a visual stimulus; impaired memory; stomach discomfort; and effects to the liver and kidneys. May also cause adverse effects to the nervous system. Benzene is a known carcinogen.	Degrade through chemical reactions in the atmosphere and contribute to carbon-based radicals that contribute to formation of ground-level ozone and its human health effects.
	Aldehydes including formaldehyde	Probable carcinogen: lung and nasopharyngeal cancer. Eye, nose, and throat irritation, respiratory symptoms.	
Hazard information compiled from toxicological profiles and concise chemical assessment documents for specific pollutants published by the Agency for Toxic Substances and Disease Registry and World Health Organization and available on-line (ATSDR, 2011; WHO, 2011).			

[Page 13]

3.3 Health and Environmental Impacts

Acid Gases

Hydrogen chloride and hydrogen fluoride are strongly corrosive acids, and coal-burning power plants are reported to be the largest anthropogenic source of hydrogen chloride and hydrogen fluoride emissions to air (USEPA, 2007). The amounts of hydrogen chloride and hydrogen fluoride produced by a particular power plant depend in large part on the concentrations of chloride and fluoride in the coal that is burned, and whether any emission control systems are in use.

Hydrogen fluoride is emitted as a gas or particle and can be adsorbed onto other particles (USEPA, 1998). Hydrogen fluoride particles tend to remain suspended in the atmosphere and can travel 500 kilometers or more as fine particles (USEPA, 1998). The majority of hydrogen chloride is believed to deposit rapidly to soil and water by wet and dry deposition or attach to particles in the atmosphere (Sanhueza, 2001).

Because of their high solubility in water, acid gas vapors can readily deposit in the upper airways. Likewise, water bound to microscopic particles can act as a "delivery system" for acids to the alveolar regions of the lung (USEPA, 1998). Controlled exposures of people with asthma have shown irritation and restriction of the airways from exposure to hydrogen chloride (Fine et al., 1987). Other studies have shown both acids to irritate and damage tissue of the eyes, nasal passages and lungs

(USEPA, 2011b). The Agency for Toxic Substances and Disease Registry (ATSDR) characterizes hydrochloric acid as "corrosive and can cause irritation and burns" at high concentrations (ATSDR, 2011). Similarly, for high exposures to hydrogen flouride the Agency states that "hydrogen fluoride is irritating to the skin, eyes, and mucous membranes, and inhalation may cause respiratory irritation or hemorrhage"

When combined with water, hydrogen chloride produces "strong acid" Strong acidity in the atmosphere also results from emissions of nitrogen-based and sulfur-based gases released from coalfired power plants. Other "strong acids" in the atmosphere can result from emissions of nitrogenbased and sulfur-based gases released from coal-fired power plants (producing nitric acid and sulfuric acid, respectively). Strong acids or their precursors that are present in inhaled particles and gases have been linked with respiratory effects in large-scale epidemiological studies. A study of 13,000 children in 24 U.S. and Canadian cities found that strong acidity in particles was associated with increased episodes of bronchitis and reduced lung function and acid gases were associated with asthma and related symptoms in children (Raizenne et al., 1996; Dockery et al., 1996). A more recent major children's

[Page 14]
study found also acid gases and particle pollution were associated with reduced lung function (Gauderman et al., 2004). The focus of these landmark studies on children is significant; as children are likely more vulnerable than healthy

adults to air pollution, including acidic gases and particles. Children have narrower airways, a faster breathing rate and tend to spend more time outdoors than adults, resulting in greater overall exposures (Bateson and Schwartz, 2008).

Chloride released from hydrogen chloride is associated with cloud acidity (USEPA, 1998) which can contribute to acid deposition over a regional scale. While much of the strong acidity has generally been thought to be related to sulfur dioxide and nitrogen oxide emissions, hydrogen chloride in particular likely plays a significant role in acid deposition in the vicinity of coal-burning power plants (USEPA, 1998).

Dioxins

The term dioxins refer to the family of structurally and chemically related polychlorinated dibenzo dioxins and polychlorinated dibenzo furans; another group of HAPs released to the atmosphere by coal-fired power plants. Dioxins are mainly formed as a by-product of combusting fossil fuels (WHO, 2010). Dioxins and furans are similar in chemical structure and consist of two six-sided rings composed of carbon and oxygen to which are attached either hydrogen or chlorine atoms. The number and position of chlorine atoms on these molecules determines the identity of each specific type of dioxin and furan, and also strongly influences their toxicity.

Dioxins have been measured in the atmosphere in both gas and particle forms. The low-chlorinated compounds have been found to be most prevalent in the gaseous form and the highly-chlorinated compounds dominant in particle form (Oh et al.,

2001). The compounds undergo photochemical reactions in the lower levels of the atmosphere (troposphere). The lower-chlorinated compounds are removed from the atmosphere primarily by this photochemical process in as little as one day. The higher-chlorinated compounds are often associated with small particles and may reside in the atmosphere for more than 10 days (Atkinson, 1991) during which time people can be exposed through inhalation.

Most of the higher chlorinated dioxins eventually deposit onto soil or water bodies. Deposition of airborne particle-bound dioxins is likely the most important direct source of dioxin input to water and soil ecosystems (Lohmann and Jones, 1998; Zhang et al., 2009), where they tend to accumulate in

[Page 15]
sediments and persist in the environment for many years. Dioxins have a high affinity for fatty molecules, which allows them to accumulate in aquatic and terrestrial food webs. As a result, humans can be exposed to these compounds by consumption of fish and meat. A study conducted by the Food Safety and Inspection Service of the U.S. Department of Agriculture in 2002-2003 found dioxin-like compounds in four classes of U.S. meat and poultry (Hoffman et al., 2006). Once ingested, it can take from 7-12 years for half of the most toxic dioxin; 2,3,7,8-TCDD; to leave the body (ATSDR, 2011). Dioxins have also been measured in the breast milk of nursing mothers (Lorber and Phillips, 2002).

Most of the information on health effects in humans comes from studies of people who were exposed to

dioxins through contaminated food or from occupational activities (Kogevinas, 2001). Short-term, intense exposures to dioxins can cause liver damage and skin lesions called chloracne. Long-term exposures have been shown to harm the immune system, the developing nervous system, the reproductive system and can disrupt hormone function. Human exposure to 2,3,7,8-TCDD and to some mixtures of other dioxins have been linked to an excess risk of cancer for many types of cancer. Studies have also shown a slight increased risk of developing diabetes (WHO, 2010).

Current research is focusing on the ability of dioxins to mimic natural hormones in the body and alter their normal function; i.e., a class of contaminants known as endocrine-disrupting compounds (Casals-Casas and Desvergne, 2011). A study of 1 to 9 year-old boys accidentally exposed to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) in 1976 reported that there were irreversible effects to reproductive hormone levels and reduced semen concentration and quality in those same individuals as adults 22 years later (Mocarelli et al. 2008). According to the World Health Organization (2010), "The developing fetus is most sensitive to dioxin exposure. The newborn, with rapidly developing organ systems, may also be more vulnerable to certain effects."

Radioisotopes

The scientific term radioisotope refers to forms of certain elements that are radioactive. Materials that are radioactive emit ionizing radiation that can damage cells and contribute to various forms of cancer and other illness. While coal does not contain

large amounts of radioactive material, the large volumes of coal burned in power plants lead to substantial releases of radium and uranium to the atmosphere in particle form. Combustion of coal is the leading source of radium releases to the atmosphere (ATSDR, 2011). One study estimated that 100 times more radioactivity is released from a coal-fired plant as compared to a nuclear power plant of a similar size (McBride et al., 1978).

[Page 16]
Mercury
EPA identifies mercury as one of the most toxic HAPs released by coal-fired power plants, primarily because of its ability to impair functioning of the central nervous system. Coal-fired power plants are responsible for about one-third of all mercury emissions from human activity (USEPA, 1997). After being released to the atmosphere, mercury can return to the earth in rain or snow.

The local impacts of that mercury can be seen in studies of eastern Ohio. Coal combustion was estimated to account for 70% of mercury in rainfall of Steubenville, Ohio (Keeler et al., 2006), reflecting the fact that coal-fired power plants are a major source of mercury emissions to the environment. Comparing mercury emissions from coal-fired power plants and areas of local mercury deposition between the western and eastern U.S. provides qualitative support for that conclusion as well (Figure 5).[4] In

---

[4] Note that mercury deposition shown in the map reflects contributions from all sources as well as the effects of local and regional meteorology, including wind patterns and rainfall. Consider Florida example, a state where there are few coal-

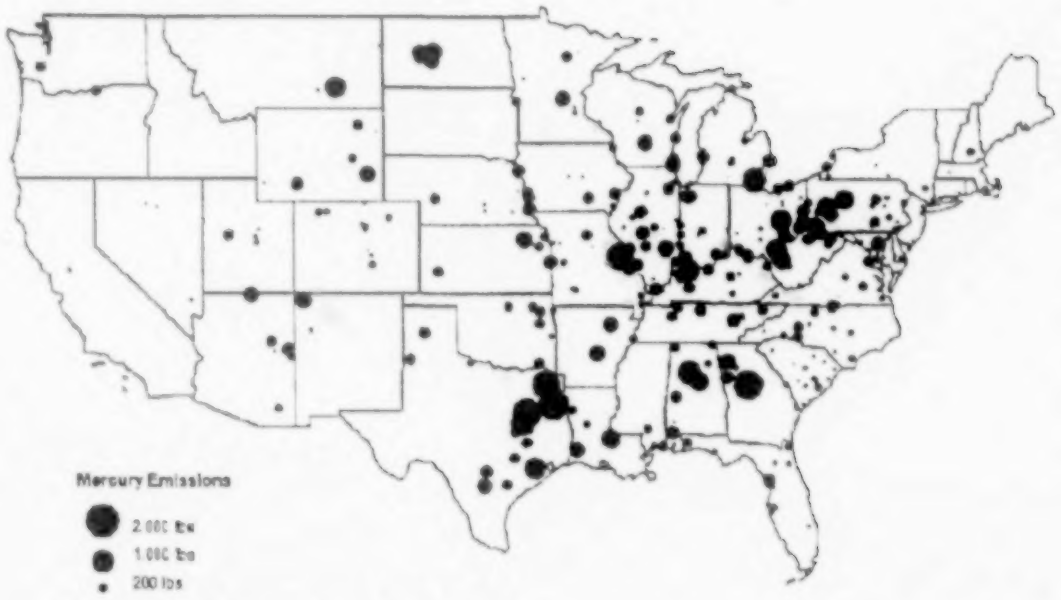
another study in eastern Ohio, 42% of the mercury in samples of rain collected in the summer was attributed to emissions from a coal-fired power plant located less than a mile away (White et al, 2009). This finding demonstrates that coal-fired power plants can be significant contributors to deposition of mercury on a local scale.

Mercury that deposits to the earth's surface from air can make its way into waterways where it is converted by microorganisms into methylmercury, a highly toxic form of mercury (Grandjean 2010). As these microorganisms are eaten by larger organisms, methylmercury concentrations increase with each successive level of the food chain, in a process called bioaccumulation. The large and long-lived predators of marine and freshwater ecosystems, including many fish favored by consumers in the U.S., end up with the highest methylmercury concentrations. As a result, consumption of fish and other aquatic organisms is the predominant pathway of exposure to mercury. The amount of mercury in people correlates with typical fish intake (MacIntosh et al., 1997; Carta et al., 2003; Mozaffarian and Rimm, 2009).

---

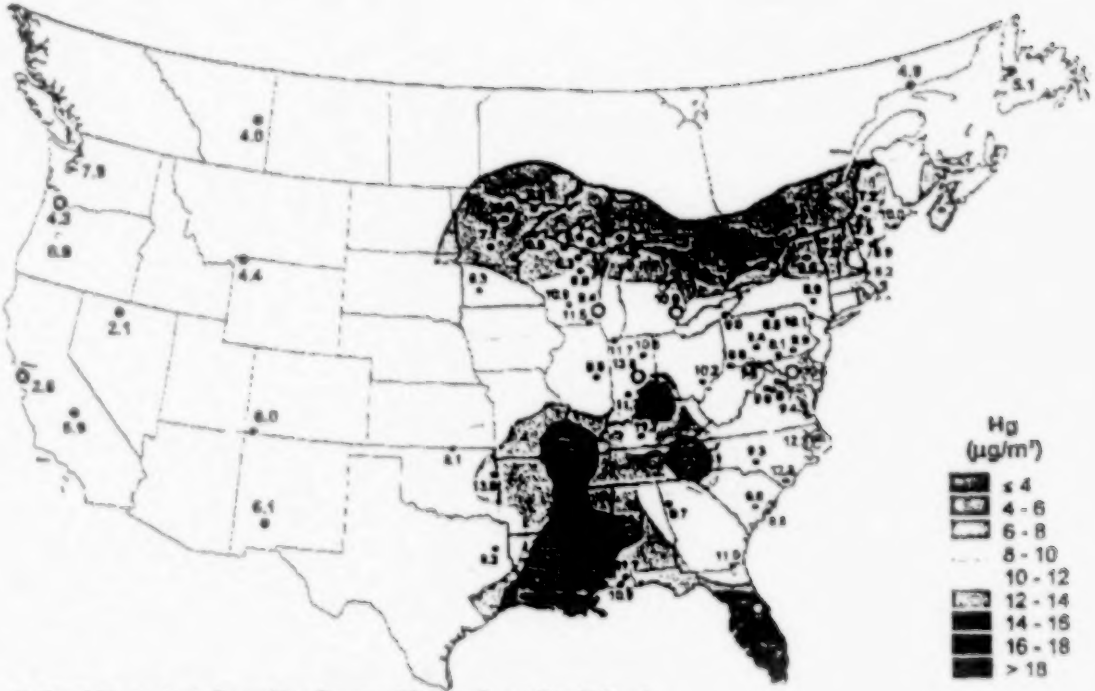
fired power plants, yet mercury deposition is high in comparison to some other areas of the country. Burning of everyday garbage (i.e., incineration of municipal solid waste) is known to be an important local source of mercury deposition in Florida (Marsik et al., 2009)

Panel A: Location and Size of US Power Plants by Mercury Emissions



Source: NRDC et al., Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the United States, June 2010

Panel B: Annual Amounts of Mercury Deposition in Rainfall



National Atmospheric Deposition Program/Mercury Deposition Network

In consideration of this evidence, the major public health concern for the general population is potential health effects of long term, low-level exposure to methylmercury that could result from regular consumption of contaminated fish. Because of concern about the effect of methylmercury on the developing brain in infants, numerous government agencies have issued recommendations on fish

[Page 18]
consumption to minimize dietary intake of mercury for women who are or may become pregnant, nursing mothers, and young children. Children are especially at risk because mercury exposure can interfere with nerve development, particularly in the brain (Bose-O'Reilly et al., 2010). Each year more than 300,000 children are born in the US with high enough levels of mercury in their blood to cause impaired performance on brain development tests and to cause permanent effects to intelligence (Trasande et al., 2005; Axelrad et al., 2007). As part of this public health information campaign, at least 39 states have issued advisories warning against fish consumption from local waters due to mercury contamination (USEPA, 2011c).

More recently, interest about public health of the general population and mercury in fish has begun to focus on risks of cardiovascular disease and outcomes (Domingo, 2007). Current evidence indicates that methylmercury in fish may lessen the cardiovascular benefits of regular fish consumption. As stated by Mozaffarian (2009), this is "a finding that has major implications for regulatory decisions regarding control of mercury emissions, because greater public

health benefit may be derived from fish consumption if mercury levels were decreased."

Non-Mercury Metals

Many metals present in coal are released to the atmosphere and become part of the mix of microscopic particles produced by coal-fired power plants. The majority of the mass of the microscopic particles emitted from coal-fired power plants consists of sulfur compounds which are not HAPs, but are hazardous nonetheless and addressed by a different section of the Clean Air Act. The remainder of particles includes arsenic, beryllium, cadmium, chromium, lead, manganese, mercury, nickel, radium, and other HAP and non-HAP elements.

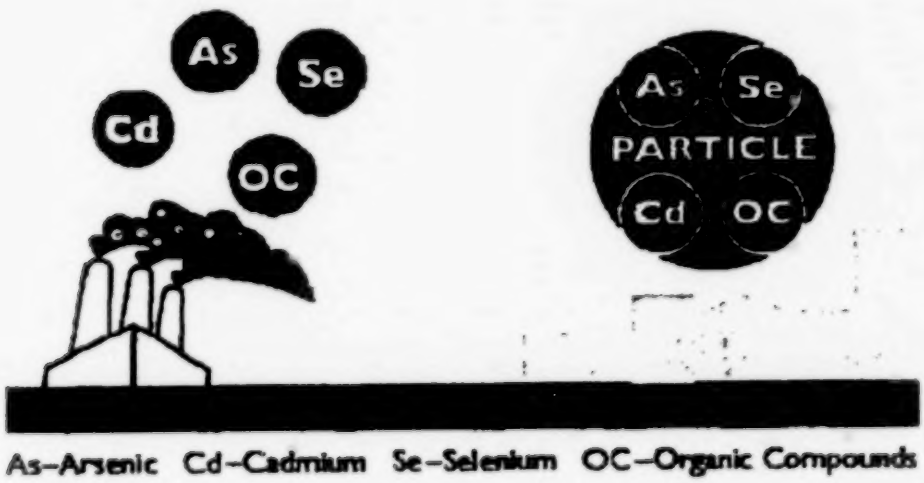


Figure 6. Hazardous Air Pollutants as a Component of Particulate Matter

[Page 19]
Emissions of these metals[5] from coal-fired power plants are frequently referred to as primary particulate matter (PM). They are distinct in origin from PM that is formed by chemical reactions in the atmosphere, so called secondary PM.[6]

> Because of the integral relationship between HAPs and particles in exhaust from coal-fired power plants, EPA established particulate matter as a surrogate for emissions of non-mercury metals from industrial boilers required to demonstrate attainment with the NESHAP for Industrial, Commercial, and Institutional Boilers and Process Heaters at Major Source Facilities (USEPA, 2011a).

The vast majority of primary PM emissions from coal-fired power plants are part of a class of air pollutants known as fine PM. Fine PM is defined as aerosols that are smaller than 2.5 micrometers ($PM_{2.5}$) and are smaller than the width of a human hair. Thus in addition to posing a hazard to human health and the environmental individually, many of the metal HAPs emitted from coal-fired power plants

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[5] As in some EPA materials, the class of pollutants referred to for simplicity here as 'metals' includes some elements (e.g. arsenic and selenium) that are not, strictly speaking, fully metallic.

[6] Emissions of sulfur dioxide and oxides of nitrogen from coal-fired power plants are a major source of secondary PM in the United States. Secondary PM can also include large organic carbon-based molecules, such as dioxins, furans, and PAHs; that attach to aerosols as they are carried through the air. Secondary PM will be discussed further in Section 5.

become part of the burden of fine particulate matter pollution in the United States (USEPA, 2009a).

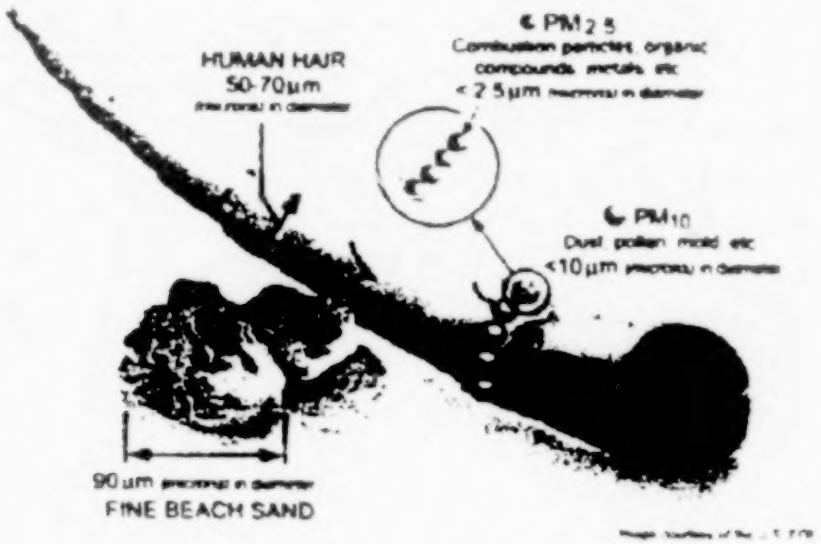

Figure 7. Fine PM: Aerosols Smaller than 2.5 microns Across ($PM_{2.5}$), Compared with a Human Hair and a Grain of Sand. (EPA Office of Research and Development, http://www.epa.gov/ord/ca/quickfinder/particulate-matter.htm)

[Page 20]
The fact that non-mercury metals emitted from exhaust stacks of coal-fired power plants comprise part of PM is important. When inhaled by people, some particles deposit along the respiratory tract, while others penetrate deeply into the lung where they can enter the bloodstream. These particles aggravate the severity of chronic lung diseases causing loss of airway function, cause inflammation of lung tissue which results in the release of chemicals that impact heart function, and leads to changes in blood chemistry that results in clots that can cause heart attacks (USEPA, 2010b). Inhalation

of $PM_{2.5}$ over both short and long periods of time is recognized to cause cardiovascular effects, including heart attacks and the associated mortality. Exposure to $PM_{2.5}$ is also a likely cause of hospital admissions for breathing problems and worsening of existing respiratory illness such as asthma. $PM_{2.5}$ exposure has been linked to other adverse respiratory, reproductive and developmental, and carcinogenic outcomes as well (USEPA 2009a; CASAC, 2010).

Some of the largest studies of health effects related to fine particles were conducted with participation from healthy adults living in areas across the United States. In one of the first and most important of these community-based studies, a research group from the Harvard School of Public Health followed over 8,000 healthy adults living in six U.S. cities for more than 14 years (the Six Cities Study). They concluded that death rates were higher in cities with higher fine particle pollution levels; in other words, people in those cities didn't live as long as people in cities with cleaner air (Dockery et al., 1993). The association between fine particles and early death was repeated in two much larger studies using an American Cancer Society (ACS) database of over 500,000 adults located in 151 cities across the country (Pope et al. 1995; Pope, et al. 2002). In 2000, a reanalysis of both the 1993 Six Cities study and data from the 1995 ACS cohort provided confirmation that fine particles could shorten life (Krewski et al., 2000). A follow-up analysis from the Six Cities Study found increased mortality associated with the fraction of $PM_{2.5}$ attributed to coal combustion (Laden et al., 2006).

The findings of community-based research are supported by results of detailed studies on individuals exposed to $PM_{2.5}$ in both everyday and laboratory settings. Those studies demonstrate that $PM_{2.5}$ exposure elicits markers of cardiovascular damage, including irregular heartbeat as well as pulmonary and systemic inflammation (USEPA 2010b). These findings provide consistent and compelling evidence of fine particle pollution health impacts. In consideration of the weight of evidence, USEPA (2009a), leading scientists (CASAC 2010; Pope and Dockery, 2006), and the American Heart Association (Brook et al., 2004) all agree that exposure to fine particles increases the risk of asthma attack, stroke, heart attack, and other serious illness as well as a variety of less serious, but important, effects including

[Page 21]
irritation of the eyes, nose, and throat, chronic bronchitis, restriction of activities, and temporary changes in lung function.

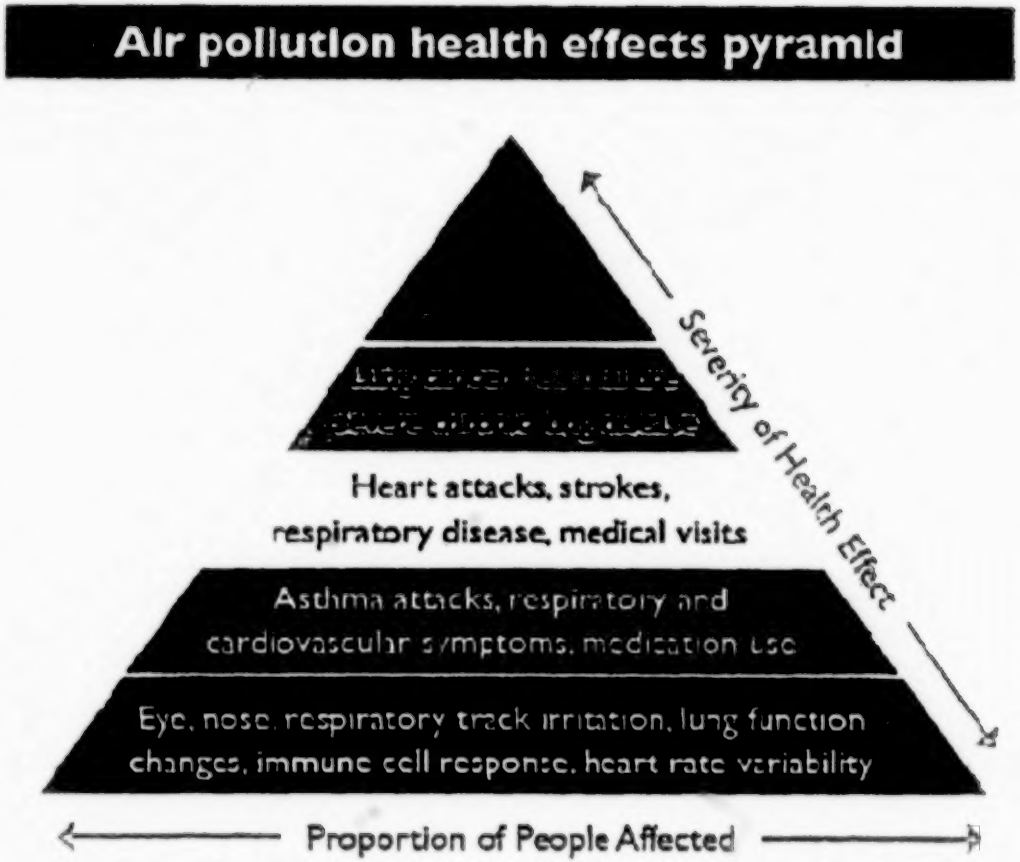

Figure 8. Air Pollution Health Effects Pyramid.

Health effects of air pollution are portrayed as a pyramid, with the mildest and most common effects at the bottom of the pyramid, and the more severe but less frequent effects at the top of the pyramid. The pyramid shows that as severity decreases the number of people affected increases. Exposure to air pollution can affect both the respiratory and the cardiac systems. Adapted from USEPA, 2010b.

The presence of metals or other pollutants in or on particles may be important in determining the toxicity of fine particles (Bell et al., 2007). Researchers have found that metals interact with particles to generate 'reactive oxygen species' which limit the body's ability to repair damage to its cells and contribute to inflammation of tissue (Carter et al., 1997; Gurgueita et al., 2002; Wilson et al., 2002; Valko, 2008). Exposure to particles enriched in sulfate, selenium, iron, nitrate, and organic carbon have been associated with immune cell response and heart variability in human volunteers (Huang et al., 2003; Chuang et al., 2007). A recent community-based study that used Medicare records from 26 communities found greater effects on hospital admissions for cardiovascular disease when the levels of certain metals, including chromium and nickel, were elevated in the $PM_{2.5}$ (Zanobetti et al., 2009). Similarly heart attack admissions were elevated for $PM_{2.5}$ enriched in arsenic, chromium, manganese, nickel and organic carbon. In the same study, diabetes-related hospital admissions were associated with

[Page 22]
PM high in arsenic, organic carbon and sulfate, potential indicators of coal combustion. Another important and recent study examined more than one million deaths across the US and found more deaths when the fraction of aluminum, sulfate and nickel in the fine particles was highest (Franklin et al., 2008). This study also found the number of deaths to be even higher for the combination of aluminum with sulfate, compared to aluminum or sulfate alone, indicating they may be more toxic when combined.

Assessments of population-based health impacts as a result of exposure to primary PM released from coal-fired power plants also indicate the importance of non-metal HAP emissions on public health. As described above, the scientific evidence for adverse cardiovascular and respiratory effects of fine particulate matter is very strong and in fact sufficient to support quantitative assessments of public health damages. The health impacts and cost to society of primary PM emissions from coal-fired power plants have been determined in a number of analyses. For example, emissions from a single 1,230 MW facility in Wisconsin were estimated to account for 7 premature deaths, 100 emergency room visits, and 520 asthma attacks each year, with an annual cost of $42 million (MacIntosh et al., 2003). Estimated impacts are significantly larger when coal-fired power plants throughout the U.S. are considered. The National Research Council (NRC) estimated $9 million of costs as a result of direct emissions of $PM_{2.5}$ from the average U.S. coal-fired power plant (NRC, 2010). The NRC analysis considered 406 coal-fired power plants across the country, which yields cumulative annual damages of $3.6 billion as a result of primary $PM_{2.5}$ emissions from those facilities.

* * *

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In the Supreme Court of the United States

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v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

UTILITY AIR REGULATORY GROUP, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

NATIONAL MINING ASSOCIATION, PETITIONER
v.
ENVIRONMENTAL PROTECTION AGENCY, ET AL.

ON WRITS OF CERTIORARI
TO THE UNITED STATES COURT OF APPEALS
FOR THE DISTRICT OF COLUMBIA CIRCUIT

JOINT APPENDIX – VOLUME 4 OF 4

Donald B. Verrilli, Jr.
Solicitor General
Counsel of Record
Department of Justice
Washington, D.C.
20530-0001
SupremeCtBriefs@usdoj.gov
(202) 514-2217

Aaron D. Lindstrom
Solicitor General
Counsel of Record
P.O. Box 30212
Lansing, Michigan 48909
LindstromA@michigan.gov
(517) 373-1124

Petitions for Writ of Certiorari Filed July 14, 2014
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Melissa Hoffer
Counsel of Record
Assistant Attorney General
Environmental Protection Division
One Ashburton Place
18th Floor
Boston, MA 02130
melissa.hoffer@state.ma.us
(617) 963-2322

Brendan K. Collins
Counsel of Record
Ballard Spahr LLP
1735 Market Street
51st Floor
Philadelphia, PA 19103
collins@ballardspahr.com
(215) 665-8500

Sean H. Donahue
Counsel of Record
Donahue & Goldberg LLP
1130 Connecticut Ave., NW
Suite 950
Washington, D.C. 20036
sean@donahuegoldberg.com
(202) 277-7085

F. William Brownell
Counsel of Record
Hunton & Williams LLP
2200 Pennsylvania Ave., NW
Washington, D.C. 20037
bbrownell@hunton.com
(202) 955-1500

Peter S. Glaser
Counsel of Record
Troutman Sanders LLP
401 Ninth Street, NW
Suite 1000
Washington, D.C. 20004
Peter.glaser@troutmansanders.com
(202) 274-2998

TABLE OF CONTENTS

VOLUME 1 OF 4

Relevant Docket Entries
White Stallion Energy Center v. *EPA*
Court of Appeals
Docket No. 12-1100 1–26

U.S. EPA, Mercury Study Report to Congress,
Vol. 1: Executive Summary, EPA-452/R-97-003
Docket No. EPA-HQ-OAR-2009-0234-3054
December 1997

Excerpts

Overview [pp. O-1 to O-4] 27–35

Report to Congress [pp. 1-1 to 1-3] 36–43

[pp. 4-1 to 4-10] 44–60

EPA Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units – Final Report to Congress, Volume 1
Docket No. EPA-HQ-OAR-2009-0234-3052
February 1998

Excerpts

Executive Summary
[pp. ES-1 to ES-29] 61–114

Utility Study Section 2.7 [p. 2-25] 115–116

Title I and Title IV,
Phase I and Phase II,
Compliance Strategy Impact
[pp. 2-31 to 2-32] 117–119

6.0 Inhalation Risk Assessment
[pp. 6-1 to 6-7] 120–131

Table 7-1 [pp. 7-8] 132–134

Areas for Further Research and Analysis
[pp. 14-8 to 14-10] 135–138

69 Fed. Reg. 4652
January 30, 2004
[pp. 4657 to 4659] 139–145

70 Fed. Reg. 15994
March 29, 2005
Sections F & G
[pp. 16019 to 16022] 146–162

Coal-to-Gas Conversion TSD,
EPA-HQ-OAR-2009-0234-3065
March 4, 2011 163–166

Memo, "National Emission Standards for Hazardous Air Pollutants (NESHAP) Beyond the Maximum Achievable Control Technology (MACT) Floor Analysis for Coal- and Oil-fired Electric Utility Steam Generating EGUs"
EPA-HQ-OAR-2009-0234-2924
March 14, 2011 167–179

National Mining Association's Comments
Docket No. EPA-HQ-2009-0234 (NESHAP action) and EPA-HQ-OAR-2011-0044 (NSPS)
76 Federal Register 24,976
May 3, 2011
Excerpt
[pp. 26 to 27] 180–185

Connecticut Department of Energy and Environmental Protection comments
EPA-HQ-OAR-2009-0234-20298
July 12, 2011
Excerpts
Cover letter and attachment
[pp. 1 to 2] 186–193

South Carolina Department of Health and Environmental Control comments
EPA-HQ-OAR-2011-0444-5749
July 20, 2011 194–213

Massachusetts Department of Environmental Protection comments
EPA-HQ-OAR-2009-0234-18039
July 29, 2011

Excerpts

[pp. 1 to 4] 214–218

[pp. 6 to 7] 219–227

New England Interstate Water Pollution Control Commission comments
EPA-HQ-OAR-2009-0234-17625
August 2, 2011 228–231

Northeast States for Coordinated Air Use Management comments
EPA-HQ-OAR-2009-0234-17843
August 2, 2011

Excerpts

[pp. 1 to 10] 232–252

Attachment A (table) [pp. A-1 to A-2] ... 253–254

VOLUME 2 OF 4

Michigan Department of Environmental Quality comments, EPA-HQ-0234-2009-0234-18426
August 3, 2011 255–277

National Association of Clean Air Agencies comments, EPA-HQOAR-2009-0234-17620
August 4, 2011

Excerpts

Cover letter and comments [pp. 1 to 10] 278–305

Attachment 1 (table) [pp. 1 to 15] 306–320

New Jersey Department of Environmental Protection, comments EPAHQ-OAR-2009-0234-18444
August 4, 2011

Excerpts

[pp. 1 to 2] 321–323

[pp. 4 to 5] 324–327

[pp. 9 to 10] 328–329

Comments of Environmental and Public Health Groups on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule. Docket No. EPA-HQ-OAR-2011-0044-5715
August 4, 2011

Excerpt

Chapter I [pp. I-1 to I-38]..... 330–382

Comments of Environmental Defense Fund on the National Emission Standards for Hazardous Air Pollutants From Coal-and Oil-Fired Electric Utility Steam Generating Units, Docket No. EPA-HQ-OAR-2009-0234-18421
August 4, 2011

Excerpt

Part I [pp. 3 to 7]..... 383–392

EPRI Comments on Proposed HAPs MACT Rule
EPA-HQ-2009-0234-17621
August 4, 2011

Excerpts

Specific Comments on the Environmental Fate and Transport, Exposure and Human Health Issues, and Risk Analyses [p. viii to x] 393–399

EPRI's comprehensive sector-wide inhalation risk assessment on all 470 coal-fired generating facilities identified no cancer or non-cancer health risks above regulatory risk threshold, in contrast to EPA's 16 case studies assessment
[pp. 3-22 to 3-27] 399–411

[pp. 3-46 to 3-48] 412–418

[pp. 3-53 to 3-56] 419–422

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17648, Part 1 of 3
August 4, 2011

Excerpts

Comment 1, Sections 1.1 through 1.2
[pp. 6 to 12] 423–436

Comment 2, Sections 2.1 through 2.3
[pp. 21 to 38] 436–468

Comment 3, entire
[pp. 38 to 53] 468–497

Comment 4, entire
[pp. 54 to 56] 497–503

Comment 5
[pp. 56 to 71] 503–532

Comment 7, Section 7.5
[pp. 88 to 90] 532–536

Comment 7, Section 7.7
[pp. 92 to 94] 536–539

Exhibit 2, MJ Bradley & Associates LLC and Analysis Group, "Ensuring a Clean, Modern, Electric Generating Fleet while Maintaining Electric System Reliability" (Aug. 2010) – Entire report, no attachments [pp. 1 to 24] 540–590

Exhibit 4, NESCAUM Report, "Control Technologies to Reduce Conventional and Hazardous Air Pollutants from Coal-Fired Power Plants" (Mar. 31, 2011) – Executive Summary
[pp. 1 to 4] 591–600

Exhibit 7, URS Report – Entire report, no appendices
[pp. 1 to 15] 601–624

VOLUME 3 OF 4

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule
Docket No. EPA-HQ-OAR-2009-0234-17651
Part 2 of 3
August 4, 2011

Excerpts

Exhibit 10, MJ Bradley Report Update – Entire report [pp. 1 to 20] 625–665

Exhibit 11, Tierney and Cicchetti Peer Review of EEI Report – Entire report [pp. 1 to 13] 666–685

Exelon Corporation, Comments on the National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units; Proposed Rule, Docket No. EPA-HQ-OAR-2009-0234-17650, Part 3 of 3
August 4, 2011

Excerpts

Exhibit 21 – Cicchetti Report – Entire report [pp. 1 to 50] 686–754

Exhibit 23 – Environmental Health & Engineering Inc. Report – Executive Summary and Sections 1.0 to 3.3 [pp. 1 to 22] 755–796

VOLUME 4 OF 4

New York Department of Environmental Conservation comments,
EPA-HQ-OAR-2009-0234-17796
August 4, 2011

Excerpts

Cover letter 797–801

Enclosure A [pp. 1 to 2] 802–806

Comments of the Utility Air Regulartory Group
August 4, 2011

Excerpts

Attachment 15 [pp. 6, 12, 15, 16] 807–810

Letter from Dr. Deborah Swackhamer and Dr. Stephen Roberts, Science Advisory Board to Lisa Jackson, Administrator, U.S. EPA,
EPA-OAR-2009-0234-18487 – Text only
Sept. 29, 2011 811–814

Supplement to the Non-Hg Case Study Chronic Inhalation Risk Assessment In Support of the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units
EPA-HQ-OAR-2009-0234-19912
November 2011

Excerpts

3. Chronic Inhalation Risk Assessment [p. 10 to 12]..... 815–817

3. Results [p. 12]..... 818

Table 9 [p. 13]..... 819–820

Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard, EPA-454/R-11-014
November 2011

Excerpts

All title pages and text pages [pp. 1 to 3]..... 821–829

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 1 of 2
December 2011

Excerpts

Response to comment 25 [p. 13]..... 830

2. Consideration of both public health and environmental effects [pp. 23 to 29] 831–847

a. Agreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [p. 39] 847

b. Disagreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis [pp. 39 to 41] 847–853

c. Agreement that EGUs were properly listed under CAA section 112(c)(1) and may not be delisted because they do not meet the delisting criteria in CAA section 112(c)(9). [pp. 52 to 54] 853–858

9. Consideration of criteria pollutants under Appropriate and Necessary Finding [pp. 55 to 59] 858–867

Response to comments 1 – 3 [p. 77] 867–869

Comment 9 and Response [pp. 79 to 81] 869–874

Response to Comment 30 [pp. 435] 874–875

EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units
EPA-HQ-OAR-2009-0234-20126
Volume 2 of 2
December 2011

Excerpts

Response to Comments 49-50
[p. 322] 876–877

Response to Comments 52-62
[pp. 328-331] 878–884

Impacts and Costs Analysis, Comment 1 and response [p. 477] 885

Impacts and Costs Analysis, Comment 5 and response [p. 478] 885–886

Impacts and Costs Analysis, Comment 10 and response [pp. 482 to 484] 886–890

Impacts and Costs Analysis, Comments 6 to 10 and responses [pp. 627 to 630] 890–899

Impacts and Costs Analysis, Comment 11 and response [pp. 630 to 631] 899–902

Impacts and Costs Analysis, Comment 12 and response [pp. 631 to 632] 902–903

Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards
EPA-HQ-OAR-2009-0234-20131
December 2011

Excerpts

Executive Summary, ES.1
[p. ES-1, Table ES-1]..... 904–907

Executive Summary, ES.1.1, Health Co-Benefits
[pp. ES-3 to ES-4]..... 908–911

Executive Summary, ES.1.2, Welfare Co-Benefits
[pp. ES-4 to ES-5]..... 911–912

Executive Summary, ES.2, Tables ES-5, ES-6, Not All Benefits Quantified
[pp. ES-9 to ES-13]..... 913–923

[pp. 3-10]..... 924–925

[pp. 3-33]..... 926–927

[pp. 5-15]..... 928–929

Chapter 4, Section 4.2 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Human Health) [pp. 4-3 to 4-5]..... 930–933

Chapter 4, Section 4.3 (Mercury and Other HAP Benefits Analysis/Impact of Mercury on Ecosystems and Wildlife) [pp. 4-6 to 4-9]..... 934–940

Chapter 4, Section 4.8.5.6 (Mercury and Other HAP Benefits Analysis/Unquantified Benefits)
[pp. 4-64 to 4-66]..... 940–944

Chapter 4, Section 4.9 (Mercury and Other HAP Benefits Analysis/Benefits Associated with Reductions in Other HAP than Mercury) [pp. 4-68 to 4-73] 944–953

Chapter 5, Synopsis (Health and Welfare Co-Benefits) [p. 5-1] 954–955

Chapter 5, Section 5.5 (Health and Welfare Co-Benefits/Unquantified Health and Welfare Benefits) [p. 5-59] 956

Memorandum, "The Environmental Protection Agency's Enforcement Response Policy for Use of Clean Air Act Section 113(a) Administrative Orders in Relation to Electric Reliability And The Mercury and Air Toxics Standard" (
December 16, 2011 957–970

Memo, "Emission Reduction Costs for Beyond-the-floor Mercury Rate for Existing Units Designed to Burn Low Rank Virgin Coal"
EPA-HQ-OAR-2009-0234-20130
December 16, 2011 971–976

Emission Reduction Costs for the Beyond-the-Floor Mercury Rate in the Toxics Rule
EPA-HQ-OAR-2009-0234-2925
Undated 977–981

The following opinions and order have been omitted in printing this Joint Appendix because they appear on the following pages in the appendix to the Petition for a Writ of Certiorari:

14-46 Michigan, et al. v. EPA, et al.

Federal Register
Volume 70, No. 59
March 29, 2005
Pages 16,000–01 ..... 116a–120a

Federal Register
Volume 76, No. 85
May 3, 2011
Pages 24,987–88 ..... 112a–115a

Federal Register
Volume 77, No. 32
February 16, 2012
Page 9,327 ..... 109a–111a

United States Court of Appeals
for the District of Columbia Circuit
Opinion in 12-1100
issued April 15, 2014 ..... 1a–105a

14-47 UARG v. EPA, et al.

APPENDIX J: U.S. Environmental Protection Agency, EPA-453/R-98-004a, Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units -- Final Report to Congress, Vol. 1 (Feb. 1998), Docket No. EPA-HQ-OAR-2009-0234-3052 (excerpts) 636a

APPENDIX I: U.S. Environmental Protection Agency, Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units; Notice of Regulatory Finding, 65 Fed. Reg. 79,825 (Dec. 20, 2000) 610a

APPENDIX H: U.S. Environmental Protection Agency, Revision of December 2000 Regulatory Finding on the Emissions of Hazardous Air Pollutants From Electric Utility Steam Generating Units and the Removal of Coal- and Oil-Fired Electric Utility Steam Generating Units From the Section 112(c) List; Final Rule, 70 Fed. Reg. 15,994 (Mar. 29, 2005)(excerpt)..... 544a

APPENDIX F: Utility Air Regulatory Group, Comments on National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units: Proposed Rule (Aug. 4, 2011), Docket No. EPA-HQ-OAR-2009-0234-17775 (excerpts)..... 510a

APPENDIX G: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Proposed Rule, 76 Fed. Reg. 24,976 (May 3, 2011) (excerpts) 514a

APPENDIX E: EPA's Responses to Public Comments on EPA's National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units, Vol. 1 (Dec. 2011), Docket No. EPA-HQ-OAR-2009-0234-20126 (excerpts)..... 506a

APPENDIX C: U.S. Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants From Coal- and Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units; Final Rule, 77 Fed. Reg. 9304 (Feb. 16, 2012) (excerpts) 105a

APPENDIX B: Opinion of the U.S. Court of Appeals for the District of Columbia Circuit.. 3a

APPENDIX A: Order of the U.S. Court of Appeals for the District of Columbia Circuit Denying All Petitions for Review, Except the Petition for Review in No. 12-1174, and Dismissing That Petition 1a

14-49 NMA v. EPA, et al.

APPENDIX F: Study of Hazardous Air Pollutant Emissions from Electric Utility Steam Generating Units (excerpts)..... 1937a

APPENDIX E: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units, Proposed Rule 76 Fed. Reg. 24,976 (May 3, 2011)..... 1161a

APPENDIX D: National Emission Standards for Hazardous Air Pollutants From Coaland Oil-Fired Electric Utility Steam Generating Units and Standards of Performance for Fossil-Fuel-Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional SteamGenerating Units, 77 Fed. Reg. 9,305 (Feb. 16 2012) 196a

APPENDIX C: 42 U.S.C.S. § 7412.....101a

APPENDIX B: In the United States Court of Appeals for the District of Columbia Circuit – Judgment (Apr. 15, 2014) 99a

APPENDIX A: In the United States Court of Appeals for the District of Columbia Circuit – Opinion (Apr. 15, 2014) 1a

New York State
Department of Environmental Conservation
Assistant Commissioner
Office of Air Resources, Climate Change & Energy,
14th Floor
625 Broadway, Albany, New York 12233-1010
Phone: (518) 402-8537 • Fax: (518) 402-8541
Website: www.dec.ny.gov

Aug -4 2001

EPA Docket Center (EPA/DC)
Environmental Protection Agency
Mail code: 2822T
1200 Pennsylvania Ave., NW
Washington, DC 20460

Comments to Docket No: EPA-HQ-OAR-2009-0234
EPA-HQ-OAR-2011-0044

Dear Sir or Madam: Joe Martens Commissioner

On behalf of the New York State Department of Environmental Conservation (NYSDEC), thank you for the opportunity to comment on the proposed 40 CFR Part 63 Subpart UUUUU, National Emission Standard for Hazardous Air Poliutants (NESHAP) from Coal and Oil fired Electric Utility Steam Generating Units and 40 CFR Part 60 New Source Performance Standards (NSPS) for Fossil Fuel Fired Electric Utility, Industrial-Commercial-Institutional, and Small Industrial-Commercial-Institutional Steam Generating Units which were published in the *Federal Register* on May 3, 2011.

We commend EPA for developing these long overdue measures that have the potential to result in substantial reductions in emissions of hazardous air pollutants such as mercury and toxic metals from this important source category. Mercury is a powerful neurotoxin that accumulates in fish and humans. Largely as a result of atmospheric deposition of mercury emitted from power plants and other sources, dozens of major water bodies is New York do not meet federal water quality standards for mercury and are the subject of fish consumption advisories. Although New York is already implementing regulations that will lead to a 90% reduction in mercury emissions from power plants by 2015, this is a national problem that requires a national solution. We urge EPA to strengthen and finalize this proposal to help provide the public health protection that is needed.

In finalizing the rule, we urge EPA to establish standards at levels that will facilitate the reduction in mercury deposition to levels that allow our water bodies to meet applicable water quality standards for mercury. Under the Clean Water Act, EPA previously approved the total maximum daily load (TMDL) for mercury submitted by New York and other northeastern states. Consistent with the requirement of section 112(d)(2) of the Clean Air Act (CAA) that EPA consider "non-air quality health and environmental impacts," EPA should consider setting the mercury standards at level that will provide adequate protection to public health and the environment and meet Clean Water Act goals, including the northeastern states' TMDL.

To assist EPA in finalizing the regulations, we identify a number of areas for improvement in detail in Enclosure A. Our primary recommendations relate to 1) the inadequacy of the Maximum Achievable Control Technology (MACT) floor for existing units, 2) certain burdensome and unnecessary emission testing requirements, and 3) the need for the rule to identify clear and consistent applicability requirements to demonstrate compliance. A summary of our significant comments follows:

- The proposed MACT floor mercury emission limit for the subcategory of Existing Coal-fired Units, with a coal heating value of greater than 8,300 British Thennal Units (Btu) per pound should be much tighter. Instead of EPA's proposed value of 1.2 lbs mercury per trillion Btu, a review of the available data from the docket indicates that the appropriate MACT-floor emission limit should be 0.44 lbs of mercury per trillion Btu (or 0.0042 lbs per Gigawatt hour (GWh) based upon 32% efficiency).

- Our recommended MACT floor for mercury of 0.44 lbs/TBtu for existing units was calculated from all units regardless of current pollution control equipment. NYSDEC has also considered a subset of these existing unit data, i.e. those that use Activated Carbon Injection (ACI) or chemically treated ACI in conjunction with other pollution control devices. Activated carbon has been demonstrated to consistently reduce mercury emissions, and EPA presented a second MACT floor determination of 1.5 lbs/TBtu using the 45 units reporting ACI usage. NYSDEC also recalculated a value of0.79lbs/TBtu for existing units for the subcategory of coal with a heat

input greater than 8,300 Btullb, a value that is also lower than that calculated by EPA.

• We question the emission testing requirements in the proposal. Although we support the use of continuous emissions monitors (CEMS) for mercury, we do not believe that the background information currently in the record supports the use of particulate matter CEMS. In addition, we question the proposed frequency of stack tests in Section 63.10006(d). As an alternative to the requirement for monthly or bimonthly stack tests (depending on the use of control devices), we recommend an alternative that will assure continuous compliance and public health benefit. Once the initial performance test is conducted for PM (filterable and condensable) and non-HAP metals, and fuel sampling procedures and operating parameters are established, compliance will be assured by the use of such fuel sampling and operating data combined with less frequent (semiannual) stack testing.

• We identify numerous instances of contradictory or unclear requirements in the proposal in Enclosure A. An important example is provided under §63.10000, *What Are My General Requirements for Complying with this Subpart,* para&rraph (c)(2), which states that liquid oil-fired EGUs can demonstrate initial and continuous compliance using fuel analysis. These general requirements are contradicted in §63.10006, which specifies different continuous compliance methods for liquid oil-fired units. The requirements for liquid oil-fired units are confusing and should be rewritten for clarity.

NYSDEC also provides responses to the questions and comments directly solicited by the USEPA and more detailed comments on numerous aspects ofthis proposal in Enclosure A. Thank you for the opportunity to comment on this important proposal.

Sincerely,
J. Jared Snyder
J. Jared Snyder
Assistant Commissioner
Office of Air Resources, Climat
Change and Energy

Attachment

cc: D. Shaw
S. Flint
K. Dalton
L. Sedefian
R. Sliwinski
B. Stanton

Enclosure A

New York State Department of Environmental Conservation's Comments on the Proposed NESHAPS and NSPS regulations for Electric Generating Units

MACT Floor Analysis for Subpart UUUUU Facilities

NYSDEC has reviewed the proposed Maximum Achievable Control Technology (MACT) floor for the subcategory Existing Coal-fired Units with a coal heating value of greater than 8,300 British Thermal Units (Btu) per pound and determined the proposed standard for mercury should be much tighter. The proposed value ils 1.2 lbs/TBtu and NYSDEC believes upon further review, the correct floor emission limit should be 0.44 lbs of mercury per trillion Btu or 0.0042 lbs per Gigawatt hour (GWh) based upon 32% efficiency.

Mercury Control Technologies

The Department of Energy (DOE) invested over 2 billion dollars for Clean Coal Technology programs. A substantial amount of that money was invested into technologies to demonstrate cost effective methodologies to reduce emissions of mercury and other pollutants from Electric Generating Units (EGUs). These technologies need to be evaluated in the MACT-floor evaluation for hazardous air pollutants in this proposal.

Mercury can exist in three forms in the flue gas of fossil fuel electric power utilities, elemental

mercury, oxidized mercury or particle bound mercury. Mercury in the oxidized form is water-soluble and behaves as a particle. These characteristics facilitate capture of mercury in wet and dry scrubber technology, fabric filters and electrostatic precipitators, with control efficiency being greater in the scrubber technologies. The use of selective catalytic reduction (SCR) for the control of nitrogen oxides have been found to increase the percent of oxidized mercury from elemental mercury in the flue gas and increase overall control efficiency from traditional pollution equipment. The Department of Energy (DOE) funded research on pilot and full scale testing showed elemental oxidation across the SCR catalysts to be within a range of 75 to 90%.[1]

At present, the most direct strategy to reduce mercury emissions from coal fired power plants has been determined to be the injection of activated carbon upstream of particle control devices. This technology was first introduced in the control of mercury in municipal waste combustor facilities. The use of halogenated activated carbon, most notably bromine, has greatly improved the capture efficiency of activated carbon alone.[2] Activated carbon injection (ACI) has been determined to be an acceptable Beyond-the-MACT floor option according to the EPA

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[1] International Conference on Air Quality, 9/2007. Blythe, G. et. al., Mercury Oxidation Catalysts for Enhanced Control by Wet FGD, URS Corporation, NETL, DOE

[2] International Conference on Air Quality, 9/2007. Sid Nelson Jr., Ronald Landreth, Ph.D., Xin Liu, Ph.D., Zhong Tang, Ph.D., & Jon Miller, Power-Plant Mercury Control Results with Brominated PAC and ESPs.

analysis submitted to TTN database.[3] The DOE and the National Energy Technology Laboratory (NETL) have managed full-scale field tests of Hg control technologies at nearly 50 U.S. coal-fired power generation facilities and as stated in their 2008 publication[4] :

> "NETL has observed a step-change improvement in both the cost and performance of Hg control during full-scale field tests with chemically-treated (or brominated) ACI. The improved Hg capture efficiency of these advanced sorbent injection systems has given coal-fired power plant operators the confidence to begin deploying technology. As of April2008, nearly 90 full-scale ACI systems have been ordered by U.S. coal-fired power generators. These contracts include both new and retrofit installations and represent over 44 GW of coal-based electric generating capacity."

DOE funded research has reported the economic costs of applying activated carbon at various sites throughout the nation. There have been several recent studies that demonstrate that costs for mercury control will continue to decrease over the years as technology improves. The cost of controlling mercury from coal-fired EGUs can approach 50% less

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[3] http://www.epa.gov/ttn/atw/utility/pro/egu beyond floor 031511 .pdf

[4] Department of Energy, Feely, T.; Jones, A.; An Update on DOEINETL's Mercury Control Field Testing Program, 2008 http://www.netl.doe.gov/technologies/coalpower/ewr/mercury/pubs

than the 1999 baseline estimates, according to an economic analysis from the U.S. DOE based on activated carbon injection. It was initially reported that the incremental costs of controlling mercury varied from $3,810/lb mercury removed to $166,000/lb of mercury removed[5]. This was later corrected to be $3,810 to $86,000/lb.

The cost and degree of reducing mercury depends greatly on the type of coal burned and any additional costs incurred to upgrade particle pollution control devices to accommodate the additional particle loading. The DOE study found that western coal, which has very low chlorine levels and emits higher amounts of elemental mercury, was more readily controlled with ACI impregnated with bromine. St. Clair DTE Energy, located in Michigan, estimated its cost at $26,200/lb of mercury controlled at 90% using a halogenated activated carbon. DOE calculated the increased cost of electricity, finding it varied from 0.14 to 3.92 mills per kilowatt-hour. Their overall conclusion is that costs of controls are decreasing for coal-fired EGUs.

The Beyond-the-MACT floor option according to the EPA analysis was determined to be $22,496 per pound mercury removed. It was most recently reported by DOE/NETL[4], "the ACI systems have the potential to remove more than 90% of the Hg in many applications based on results from NETL's field testing program, at a cost estimated to dip

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[5] Jones, A. et. al. DOE/NETL's Phase II Mercury Control Technology Field Testing Program: Preliminary Economic Analysis of Activated Carbon Injection, Environmental Science and Technology, 41 , 1365-1371,2007

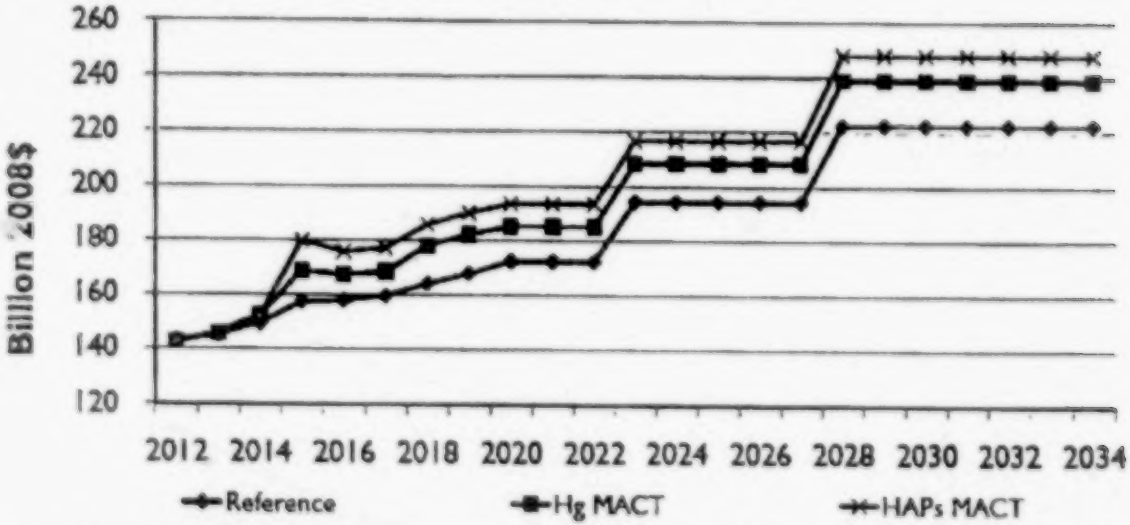
below $10,000/lb Hg removed. However, while the results achieved during NETL's field tests met or exceeded program goals, only through experience gained during long-term continuous operation of these advanced technologies in a range of full-scale commercial applications will their actual costs and performance be determined."

* * *

{Comments of the Utitlity Air Regulatory Group, August 4, 2011, Excerpts from Attachment A}
[Page 6]

Total System Cost

- Total system cost is comprised of four basic components - annualized capital cost payments, fixed O&M, variable O&M, and fuel expenditures:



- The HAPs MACT scenario increases total system cost by ~$10.5 billion over the Hg MACT case in the first year of compliance
- HAPs MACT compliance is projected to cost the power sector over $8 billion more per year than a mercury MACT policy; by 2030 the compliance cost difference is projected at greater than $9 billion annually
- In relation to the Reference Case, the HAPs MACT case costs the power sector ~$22.2 billion more in 2015; ~$21.1 billion more per year by 2020; and ~$25.7 more annually by 2030.

[Page 12]

Detailed Run Results

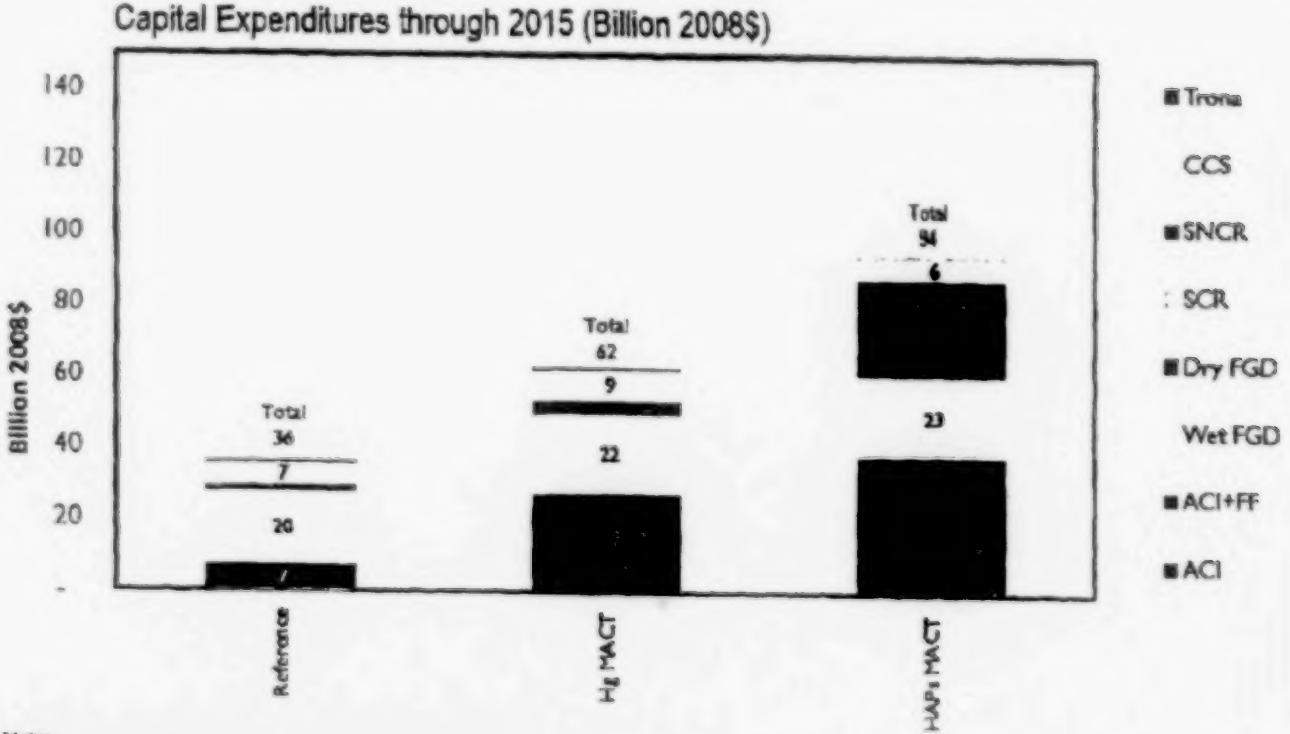
- The following slides provide a more detailed overview of:
  - Pollution control installations
  - Capacity additions
  - Retirements
  - Generation mix

- The HAPs MACT run necessitates significant additional investment beyond what is required by the Hg MACT run
  - ~$ 30 billion in overnight capital expenditures from additional pollution control installations
  - ~$13 billion in overnight capital expenditures from additional new capacity additions

- The EPA Air Toxics run is included for comparison purposes; however, it should be noted that there are significant differences in the underlying assumptions between the EPA Air Toxics run and the HAPs MACT run

[Page 15]

National Pollution Control Installations Summary: (Firm + Economic) – Through 2015

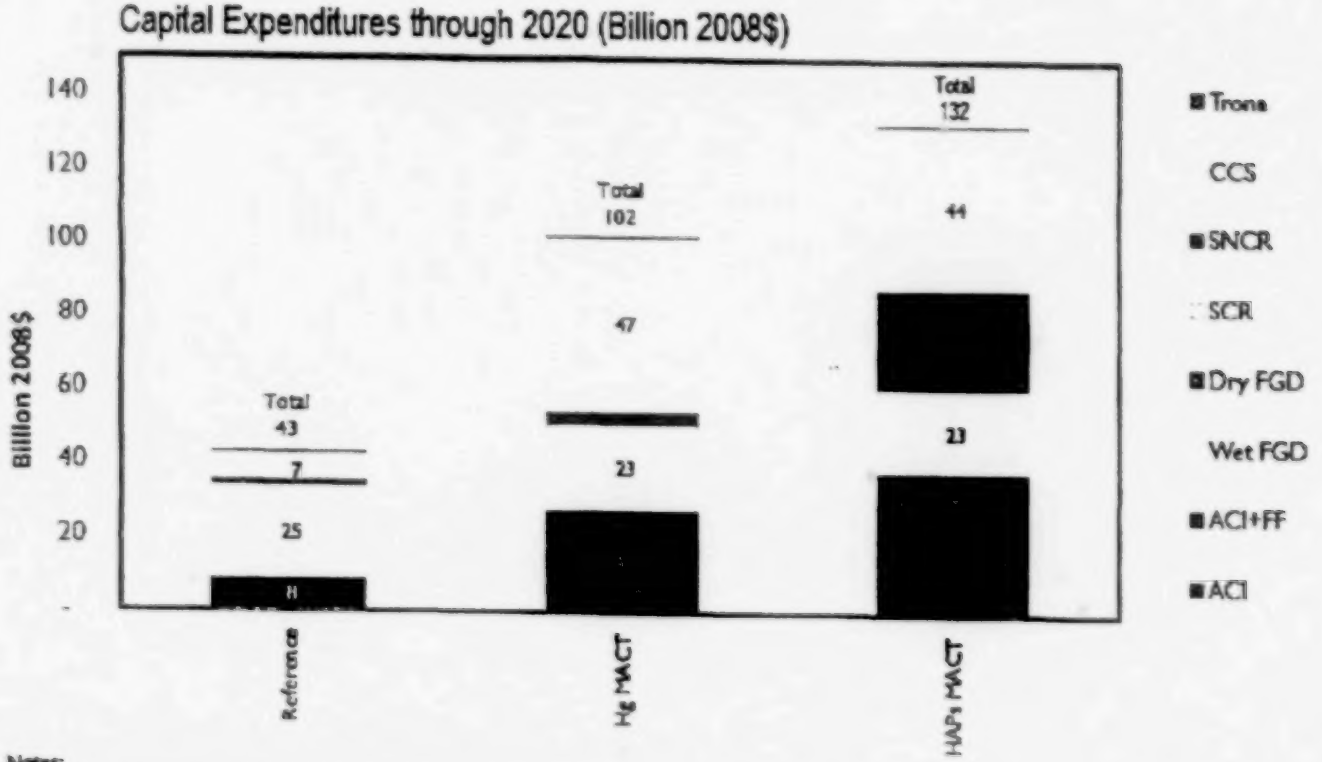


Notes:

1. Capital Expenditures include total overnight costs and AFUDC/IDC.
2. Unlabeled control installation segments are $6 billion or less each.

[Page 16]

National Pollution Control Installations Summary: (Firm + Economic) – Through 2020



Notes:

1. Capital Expenditures include total overnight costs and AFUDC/IDC.
2. Unlabeled control installation segments are $7 billion or less each.

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY
WASHINGTON D.C. 20460

OFFICE OF THE ADMINISTRATOR
SCIENCE ADVISORY BOARD

September 29, 2011

EPA-SAB-11-017
The Honorable Lisa P. Jackson
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20460

Subject: Review of EPA's Draft National-Scale Mercury Risk Assessment

Dear Administrator Jackson:

EPA's Office of Air and Radiation requested that the Science Advisory Board (SAB) review a draft *Technical Support Document: National-Scale Mercury Risk Assessment Supporting the Appropriate and Necessary Finding for Coal and Oil-Fired Electric Generating Units- March 2011.* The goal of this draft document is to characterize human health exposure and risk associated with U.S. electrical generating unit (EGU) mercury emissions with a focus on a highly exposed subpopulation, subsistence fishers. The SAB was asked to comment on the risk assessment, including the overall design and approach, as well as the use of specific models and key assumptions. The SAB was also asked to

comment on the extent to which specific facets of the assessment are well characterized in the Technical Support Document.

The SAB could not evaluate the risk assessment based solely upon information provided in the Technical Support Document. Important elements of the methods and findings are missing or poorly explained. Additional information provided by EPA representatives during an SAB public meeting on June 15-17, 2011 and a public teleconference on July 12, 2011 allowed the SAB to gain a sufficient understanding of the risk assessment to conduct this review.

The risk assessment is designed to assess how a reduction in mercury emissions will translate to reductions in fish tissue methylmercury concentrations, and in turn, to a reduction in potential risk to subsistence fishers that would result from the consumption of self-caught fish from inland watersheds. EPA sought advice from the SAB on key components of its analysis. In response, the SAB reviewed available information and has made the following findings. The SAB considers the spatial resolution of the modeling of mercury deposition to watersheds to be appropriate for the analysis. There is agreement that the approach used to identify watersheds to include in the assessment is reasonable. This approach is based upon the availability of fish tissue methylmercury data and census data on target populations with potential subsistence fishers. The SAB agrees that EPA's calculation of a hazard quotient for each watershed is appropriate as the primary means of expressing

risk because it is based on an established reference dose for methylmercury that reflects a range of potential neurobehavioral effects. Intelligence Quotient (IQ) loss is also used in the assessment to evaluate risk. The SAB considers IQ loss to be an insensitive indicator of methylmercury neurobehavioral effects and is concerned that its use as an endpoint could underestimate risk. The SAB recommends that IQ loss be de-emphasized in the risk assessment and explored as one of several possible secondary public health endpoints as a supplement to the main analysis. Although the SAB considers the number of watersheds included in the assessment adequate, some watersheds in areas with relatively high mercury deposition from U.S. EGUs were under-sampled due to lack of fish tissue methymercury data. The SAB encourages the Agency to contact states with these watersheds to determine if additional fish tissue methylmercury data are available to improve coverage of the assessment.

The SAB identifies additional sources of variability and uncertainty in the risk assessment, as well as limitations imposed by the availability of data. The uncertainties are appropriate for a screening-level public health assessment. The SAB regards the design of the risk assessment as suitable for its intended purpose, to inform decision-making regarding an "appropriate and necessary finding" for regulation of hazardous air pollutants from coal and oil-fired EGUs, provided that our recommendations are fully considered in the revision ofthe assessment.

In summary, based on its review of the draft Technical Support Document and additional

information provided by EPA representatives during the public meetings, the SAB supports the overall design of and approach to the risk assessment and finds that it should provide an objective, reasonable, and credible determination of the potential for a public health hazard from mercury emitted from U.S. EGUs. The SAB finds the current draft document deficient, however, because of its lack of transparency in describing key analytical methods and findings. We urge the Agency to revise the document based on our recommendations.

We appreciate the opportunity to review the draft mercury risk assessment. We look forward to your response.

Sincerely,

/Signed/	*/Signed/*
Dr. Deborah L. Swackhamer	Dr. Stephen M. Roberts
Chair	Chair
Science Advisory Board	SAB Mercury Review Panel

{Supplement to the Non-Hg Case Study Chronic Inhalation Risk Assessment In Support of the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units
EPA-HQ-OAR-2009-0234-19912
November 2011}
[Page 10]

3. Chronic Inhalation Risk Assessment

For chronic inhalation exposures, we used the 5-year average ambient concentrations of HAP estimated from the refined dispersion modeling. The estimated ambient concentration at each nearby census block centroid was used as a surrogate for the chronic inhalation exposure concentration for all the people who reside in that census block. We assessed non-cancer health effects from chronic exposures by comparing the chronic inhalation exposure concentration to the Reference Concentration values. We calculated the maximum individual risk, or MIR, for each facility as the cancer risk associated with a continuous lifetime (24 hours per day, 7 days per week, and 52 weeks per year for a 70-year period) exposure to the maximum concentration at the centroid of an inhabited census block. Individual cancer risks were calculated by multiplying

[Page 11]
the estimated lifetime exposure to the ambient concentration of each HAP (in micrograms per cubic meter) by its cancer unit risk estimate (URE), which is an upper bound estimate of an individual's probability of contracting cancer over a lifetime of exposure to a concentration of 1 microgram of the pollutant per cubic meter of air. We used URE values

for arsenic and hexavalent chromium from EPA's Integrated Risk Information System (IRIS), which is a human health assessment program that evaluates quantitative and qualitative risk information on effects that may result from exposure to environmental contaminants. Unit risk estimates in IRIS have undergone both internal and external peer review.

In the preamble to the proposed rule, we discussed the reasons for using 65% of the IRIS URE for nickel subsulfide for all nickel compounds. In July 2011, we completed an external peer review (using three independent expert reviewers) of the methods used to evaluate the risks from nickel compounds emitted by EGUs in a report titled, "Methods to Develop Inhalation Cancer Risk Estimates for Chromium and Nickel Compounds."[3] Based on the views of major scientific bodies such as the International Agency for Research on Cancer (IARC), the World Health Organization (WHO), and the European Union's Scientific Committee on Health and Environmental Risks (SCHER), and those of the expert peer reviewers who commented on our approaches to risk characterization of nickel compounds, we consider all nickel compounds to be carcinogenic as a group and do not consider nickel speciation or nickel solubility to be strong determinants of nickel carcinogenicity.

Based on this review, we decided to use 100 percent of the current IRIS URE for nickel

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[3] Mercury and Air Toxics Standards Rule Docket, ID No. EPA-HQ-OAR-2009-0234. Available at www.regulations.gov.

subsulfide, rather than assuming that 65 percent of the total mass of emitted nickel might be nickel subsulfide, as used in previous analyses. We used the IRIS URE value because IRIS values are typically preferred for use in HAP risk assessments performed in support of air toxics regulations under the Clean Air Act.[4] The IRIS values are preferred because they are developed in accordance with EPA risk assessment guidelines and because of the level of peer review IRIS values receive. We used 100 percent of the IRIS value because of the concerns about the potential carcinogenicity of all forms of nickel raised by the major national and international scientific bodies. Nevertheless, taking into account that there are potential differences in toxicity and/or carcinogenic potential across the different nickel compounds, and given that there have been two URE values derived for exposure to mixtures of nickel compounds that are 2-3 fold lower than the IRIS URE for nickel subsulfide[5], the EPA also considers it reasonable to use a value that is 50 percent of the IRIS URE for nickel subsulfide for providing an estimate of the lower end of a plausible range of cancer potency values for different mixtures of nickel compounds.

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[4] http://www.epa.gov/ttn/atw/toxsource/chronicpriority.html

[5] Two UREs (other than the current IRIS values) have been derived for nickel compounds: one developed by the California Department of Health Services (http://www.arb.ca.gov/toxics/id/summary/nickel_tech_b.pdf) and the other by the Texas Commission on Environmental Quality (http://www.epa.gov/ttn/atw/nata1999/99pdfs/healtheffectsinfo.pdf).

[Page 12]

The health reference values used in the assessment are given in Table 8. 12

Table 8. Health reference values used in the assessment.

Pollutant	CAS Number	URE (1/µg/m3)	Source	RfC (mg/m^3)	Source
Arsenic	7440382	4.3E-03	IRIS	0.000015	CalEPA
Chromium (VI)	18540299	0.012	IRIS	0.0001	IRIS
Nickel	7440020	0.00048	IRIS	0.00009	CalEPA
HCl	7647010			0.02	IRIS

3. Results.

The results of the assessment are given in Table 9. Based on estimated actual emissions, the highest estimated lifetime cancer risk from any of the sixteen case study facilities was 20 in a million, driven by nickel emissions from the one case study facility with only oil-fired EGUs. For the facilities with coal-fired EGUs, there were five with maximum cancer risks greater than 1 in a million (the highest was five in a million), four driven by hexavalent chromium, and one driven by nickel from an oil-fired EGU. There were also two facilities with coal-fired EGUs with cancer risks at 1 in a million. All of the facilities had non-cancer target-organ-specific hazard index (HI) values less than one, with a maximum HI value of 0.4 (also driven by nickel emissions from the one case study facility with only oil-fired EGUs).

The cancer risk estimates from this assessment indicate that the EGU source category would not be eligible for delisting under section 112(c)(9)(B)(i) of the CAA, which specifies that a category may be delisted only when the Administrator determines "... that no source in the category (or group of sources in the case of area sources) emits such hazardous air pollutants in quantities which may cause a lifetime risk of cancer greater than one in one million to the individual in the population who is most exposed to emissions of such pollutants from the source...." We note that, since these case studies do not cover all facilities in the category, and since our assessment does not include the potential for impacts from different EGU facilities to overlap one another (i.e., these case studies only look at facilities in isolation), the maximum risk estimates from the case studies may underestimate true maximum risks.

[Page 13]

Table 9. Chronic inhalation risk assessment results.

Facility	Proposed Rule Assessment				Final Rule Assessment			
	Max Risk	Risk Driver	Max HI	HI Driver	Max risk	Risk Driver	Max HI	HI Driver
Xcel Bayfront	$4.0x10^{-6}$	Formaldehyde	0.005	HCl	Not Remodeled			
Cambria Cogen	$5.0x10^{-7}$	Chromium VI	0.003	Nickel	Not Remodeled			
SC&E Canadys	$6.0x10^{-7}$	Arsenic	0.009	HCl	Not Remodeled			
Dominion Chesapeake Energy Center	$3.0x10^{-6}$	Chromium VI	0.05	HCl	2x10-6	Chromium VI	0.05*	HCl*
Conesville	$3.0x10^{-6}$	Chromium VI	0.01	Nickel	2x10-6	Chromium VI	0.008	Nickel
Exelon Cromby Generating Station	$3.0x10^{-7}$	Arsenic	0.008	Nickel	Not Remodeled			
TVA Gallatin	$1.0x10^{-6}$	Chromium VI	0.006	Nickel	2x10-6	Chromium VI	0.007	Nickel
City Utilities of Springfield - James River	$8.0x10^{-6}$	Chromium VI	0.04	Nickel	5x10-6	Chromium VI	0.03	Nickel

Amerenue-Labadie	$8.0x10^{-7}$	Arsenic	0.006	Arsenic	7x10-7	Chromium VI	0.004	Arsenic
PSHNH - Merrimack	$1.0x10^{-6}$	Arsenic	0.01	Arsenic	1x10-6	Arsenic	0.01	Arsenic
Monticello Steam Electric Plant	$6.0x10^{-7}$	Chromium VI	0.003	Arsenic	Not Remodeled			
OG&E - Muskogee	$1.0x10^{-6}$	Arsenic	0.01	Arsenic	1x10-6	Chromium VI	0.008	Arsenic
Spruance Genco	$8.0x10^{-6}$	Arsenic	0.007	HCl	Not Remodeled			
PSI Energy – Wabash River	$1.0x10^{-7}$	Arsenic	0.001	Arsenic	Not Remodeled			
Heco Waiau	$1.0x10^{-5}$	Nickel	0.4	Nickel	2x10-5[b]	Nickel	0.4	Nickel
Dominion - Yorktown	$1.0x10^{-6}$	Chromium VI	0.02	Nickel	2x10-6[b]	Nickel	0.03	Nickel

[a] Although HCl was not included in the remodeling of this facility, HCl was the HI driver pollutant at proposal, and this is carried through for the final rule assessment.

[b] Based on considering the emitted nickel to be 100% as potent a carcinogen as pure nickel subsulfide; if we consider the emitted nickel to be 50% as potent a carcinogen as nickel subsulfide (see text), estimated risks would be $1x10^{-5}$ for Heco Waiau and $1x10^{-6}$ for Dominion - Yorktown.

Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard

EPA-454/R-11-014
November 2011

Memorandum: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard

Marc Houyoux
and
Madeleine Strum
Emission Inventory and Analysis Group
Air Quality Assessment Division

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Assessment Division
Emissions Inventory and Analysis Group
Research Triangle Park, North Carolina

[Page 1]
MEMORANDUM

To: Toxics Rule docket, number EPA-HQ-OAR-2009-0234

From: Marc Houyoux, group leader Emission Inventory and Analysis Group
Madeleine Strum, Emission Inventory and Analysis Group

Subject: Emissions Overview: Hazardous Air Pollutants in Support of the Final Mercury and Air Toxics Standard

Date: December 1, 2011

1 Introduction

The purpose of this document is to summarize the mercury (Hg) and non-Hg Hazardous Air Pollutants (HAP) emissions from U.S. electric generating utilities (EGUs) associated with the final Mercury and Air Toxics Standard (MATS). This information includes both background information about these pollutants as well as emissions totals from several emissions cases developed for the final MATS. In this memo, we summarize current HAP emissions estimates from U.S. EGUs, the estimates used in the national-scale Hg risk assessment (Hg Risk TSD) for years 2005 and 2016, and the estimates for the future impact of the rule when fully implemented (in 2016).

2 Hg Emissions

2.1 Hg Emissions Overview

Mercury is an element. There is a fixed amount of it in the world. As long as it is bound up, for example in coal, it cannot affect people or the environment. Once it is released, for example via the combustion process, it enters the environment and becomes available for chemical conversion. Once emitted, Hg remains in the environment and can bioaccumulate in organisms or be remitted through

natural processes. Mercury is emitted through natural and anthropogenic processes, and previously deposited Hg from either process may be re-emitted. The majority of natural Hg emissions arise from volcanoes, geothermal activity, Hg-enriched topsoil, oceans/lakes, and vegetation. The category of natural Hg emissions may or may not include biomass burning, due to the difficulty in determining whether biomass burning events are started by anthropogenic or natural causes. Generally, natural Hg emissions are dominated by the elemental form of mercury, and as a result have more impact on the global pool of Hg than on deposition in the region of the emissions.

Mercury is known to exist in the atmosphere in three forms: (1) elemental mercury, Hg^0, (2) gaseous oxidized mercury, Hg^{+2}, and (3) particulate bound mercury, Hg_p. Hg^0 dominates total mercury composition in the atmosphere (greater than 95%) and has a much greater residence time than Hg^{+2} or Hg_p[1]. Hg^0 ambient concentrations are spatially uniform due to the long atmospheric residence time and a more uniform distribution of sources due to re-emission of previously deposited mercury. Hg^{+2} and Hg_P concentrations are locally elevated near sources due to their shorter atmospheric lifetime. Total mercury deposition is likely to be dominated by all sources of Hg^0 including global sources, while

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[1] Schroeder, W. H. and J. Munthe (1998). "Atmospheric mercury - An overview." Atmospheric Environment **32**(5): 809-822.

deposition of Hg^{+2} and Hg_p is primarily from local and regional sources.[2]

[Page 2]

The categories for anthropogenic Hg emissions include the combustion of fossil-fuels, cement production, waste incineration, metals production, and other industrial processes. Anthropogenic Hg emissions consist of all three forms of Hg.

Mercury re-emissions include previously deposited Hg originating from both natural and anthropogenic sources. At this time, it is not possible to determine the original source of previously deposited Hg, i.e., whether its source is natural emissions or re-emissions from previously deposited anthropogenic Hg.[3,4,5] Current publications on this topic estimate that half of re-emitted Hg originates from anthropogenic sources.[6,7]

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[2] Marsik, F. J., G. J. Keeler, et al. (2007). "The dry-deposition of speciated mercury to the Florida Everglades: Measurements and modeling." Atmospheric Environment 41(1): 136-149.

[3] Lindberg, S., Bullock, R., Ebinghaus, R., Engstrom, D., Feng, X., Fitzgerald, W., et al. (2007). A Synthesis of Progress and Uncertainties in Attributing the Sources of Mercury in Deposition. *Ambio, 36*(1), 19-33.

[4] Lohman, K., Seigneur, C., Gustin, M., & Lindberg, S. (2008). Sensitivity of the global atmospheric cycle of mercury to emissions. *Applied Geochemistry, 23*(3), 454-466.

[5] Seigneur, C., Vijayaraghavan, K., Lohman, K., Karamchandani, P., & Scott, C. (2004). Global Source Attribution for Mercury Speciation in the United States. *Environmental Science and Technology*(38), 555-569.

[6] Mason, R., Pirrone, N., & Mason, R. P. (2009). Mercury emissions from natural processes and their importance in the

Current estimates of total global Hg emissions based on a 2005 inventory range from 6,600 to 7,500 metric tons per year (mt/yr). The United Nations Environment Programme (UNEP) estimates of global Hg emissions for 2005 are somewhat lower, at 5,600 mt/yr[8,9]. Global anthropogenic Hg emissions, excluding biomass burning, have been estimated by many researchers. UNEP's 2005 estimate is approximately 1,900 mt/yr (with a range of 1,200 to 3,000 mt/yr)[10] and the 2005 estimate by Pirrone, et al. is approximately 2,400 mt/yr. [11] Global fossil-fuel fired power plants total approximately 500 to 800

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global mercury cycle. In *Mercury Fate and Transport in the Global Atmosphere* (pp. 173-191): Springer U.S.

[7] Selin, N. E., Jacob, D. J., Park, R. J., Yantosca, R. M., Strode, S., Jaeglé, L., et al. (2007). Chemical cycling and deposition of atmospheric mercury: Global constraints from observations. *J. Geophys. Res, 112*, 1071-1077.

[8] UNEP (United Nations Environment Programme), Chemicals Branch, 2008. The Global Atmospheric Mercury Assessment:Sources, Emissions and Transport, UNEP Chemicals, Geneva.

[9] The 5,600 metric ton estimate is from the Figure on page 37 of the report. The report also provides ranges in the executive summary.

[10] Study on Mercury Sources and Emissions and Analysis of the Cost and Effectiveness of Control Measures "UNEP Paragraph 29 study", UNEP (DTIE)/Hg/INC.2/4. November, 2010.

[11] Pirrone, N., Cinnirella, S., Feng, X., Finkelman, R. B., Friedli, H. R., Leaner, J., et al. (2010). Global mercury emissions to the atmosphere from anthropogenic and natural sources. *Atmospheric Chemistry and Physics Discussions*, 10(2), 4719-4752.

mt/yr, a large fraction (25 to 35 percent) of the total global anthropogenic emissions.[12]

There are large uncertainties regarding projected mercury global inventories. To model Hg deposition for the national-scale Hg risk assessment, initial and boundary conditions were based on a GEOS-CHEM simulation using a 2000-based global inventory that includes approximately 7,000 mt/yr of mercury emissions[13]. Recent research shows that Hg emissions from China were consistent between 2000 and 2006 (approximately 1,300 mt/yr)[14], so no adjustments were made to the 2000-based global Hg emissions for the 2005 simulation. Recent research has shown that ambient mercury concentrations have been decreasing in

[Page 3]
the northern hemisphere since 2000[15], so no adjustments were made to the boundary condition inflow for the 2016 simulations.

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[12] Study on Mercury Sources and Emissions and Analysis of the Cost and Effectiveness of Control Measures "UNEP Paragraph 29 study", UNEP (DTIE)/Hg/INC.2/4. November, 2010.

[13] Selin, N.E., Jacob, D.J., Park, R.J., Yantosca, R.M., Strode, S., Jaegle, L., Jaffe, D., 2007. Chemical cycling and deposition of atmospheric mercury: Global constraints from observations. Journal of Geophysical Research-Atmospheres 112.

[14] Streets, D.G., Zhang, Q., Wu, Y., 2009. Projections of Global Mercury Emissions in 2050. Environmental Science & Technology 43, 2983-2988.

[15] Slemr, F., Brunke, E.G., Ebinghaus, R., Kuss, J., 2011. Worldwide trend of atmospheric mercury since 1995. Atmospheric Chemistry and Physics 11, 4779-4787.

2.2 Estimating Current Hg Emissions

In 1990, Hg emissions for coal and oil EGUs in the U.S. were 59 tons[16] out of a total of 246 tons[17], and by 1999 Hg emissions for U.S. EGUs were 49[18] out of 115 tons. In 2005, they were 53[19] tons out of a total of 105 tons. As part of the development of the MATS, EPA completed in 2010 an Information Collection Request (ICR) that gathered the latest available emissions data from coal- and oil-fueled EGUs. The ICR data have been used in several ways, including to calculate EPA's best estimate of current emissions, called the "current base" from U.S. EGUs. At proposal, the current base Hg emissions estimate (labeled "2010" at proposal) was 29 tons, and after the revisions made and described here for the final MATS, the current base estimate remains 29 tons of Hg from U.S. EGUs.

While the current base Hg emissions estimate is not a basis for the MATS rule, the risk assessment, or the Regulatory Impact Analysis (RIA), EPA received numerous comments on its value as part of the proposed rule. These comments compared the current base estimate to EPA's future year Hg emissions estimate from U.S. EGUs and called into

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[16] 2008 EPA Report on the Environment available at http://www.epa.gov/ncea/roe/index.htm

[17] This value was transposed as 264 tons in the version of this memorandum included with the MATS proposal.

[18] ftp://ftp.epa.gov/pub/EmisInventory/finalnei99ver3/haps/summaries

[19] Emission Inventory Technical Support Document (TSD) for the proposed MATS rule

question the future-year estimate since it was the same as the current base estimate. Since the current base estimates use a 2007-2009 average heat input, it did not seem likely that the current base estimate would be the same as future years that include additional controls from other rules. As a result, EPA has reviewed and updated its methods for the current base emissions, and these updates are described in this section. These changes resulted in a decrease of 0.3 tons/year, which rounds to the same 29 ton/yr value included with the proposed MATS.

The calculations underlying the current base inventories are available in the MATS docket in an Excel® workbook entitled "MATS_Final_Current_Base_HAP_inven.xlsx"

EPA updated the current base national inventories for the final rule in the following three ways:

- Updated list of units assumed to be subject to the rule for the purposes of calculating the national inventory values. Within a given facility, some units are subject to the rule and some are not depending on each unit's capacity and fuels.

- Revised EFs for untested units. These revisions included outlier statistical tests of the underlying stack test data for each pollutant to improve the quality of the estimates. This approach was also consistent with the EF method used to estimate emissions for untested units in the non-Hg risk case studies.

- Revised the heat input to use the 2007-2009 average CEM-based heat input for units reporting to the CEM program, rather than ICR-based heat input. For other units, EPA used the same approach as at proposal, which was based on the ICR data and also represents a 2007-2009 average.

EPA's Responses to Public Comments on EPA's *National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units*
December 2011

Volume 1 of 2

Comments, letters, and transcripts of the public hearings are also available electronically through *http://www.regulations.gov* by searching Docket ID *EPA-HQ-OAR-2009-0234.*

* * *

[Page 13]
Response to Comment 25: The EPA does not agree with the commenter's interpretation ofCAA section 112. We maintain that our interpretation of the statute and our authority there-under is reasonable for the reasons set forth in the proposed rule. We specifically disagree with commenter's interpretation as it relates to the title IV Acid Rain program, because we do not believe the manner in which EGUs were regulated under that program alters the agency's responsibility when regulating EGUs under CAA section 112.

The commenter incorrectly characterizes the agency's legal rationale for the EGU NESHAP. The basis for listing and regulating EGUs under CAA section 112 was in 2000, and remains today, that HAP emissions from EGUs pose a hazard to public health and the environment. A consequence of the rule will be that uncontrolled EGUs that Congress

believed would retire decades ago will have to install controls to keep operating.

Further, the commenter's assertion that the title IV Acid Rain program currently requires pollution controls for all EGUs is not accurate. The acid rain program is a trading program that allows some sources to run uncontrolled for NO_x and SO_2 if they purchase emission allowances.

* * *

[Page 23]

2. Consideration of both public health and environmental effects.

Commenters: 17383, 17608, 17648, 17681, 17716, 17731, 17775, 17798, 17834, 17855, 17877, 18033, 18502, 19114, 19536/19537/19538, 18023

a. Commenters supporting the EPA's interpretation that CAA section 112(n)(1) allows consideration of both public health and environmental effects.

Comment 17: Commenter 17648 states that EPA properly considered both health and environmental effects in determining that it is appropriate to regulate EGUs. According to the commenter, the health hazard derives directly from the deposition of Hg emissions from EGUs into the environment where it is converted to MeHg and bioaccumulates in fish through the food chain. The commenter states that humans who consume fish with elevated Hg levels are exposed to the risks attendant to such elevated concentrations, and any interpretation

excluding consideration of environmental effects would be absurd.

[Page 24]
Comment 18: Commenter 17648 agrees with the EPA with respect to evaluating whether HAP emissions from EGUs have environmental effects. The commenter states that the agency appropriately measures the impact in light of the statutory definition of "adverse environmental effect" in CAA section 112(a)(7). According to the commenter, that definition reflects clear Congressional intent to allow the agency to consider a wide range of effects, noting that it includes "any" enumerated effect "which may reasonably be anticipated." The commenter states that Congress reinforced this intent in requiring the EPA to consider additional standards within 8 years of promulgation of standards under CAA section 112(d), both to assure "an ample margin of safety to protect public health" and to prevent an "adverse environmental effect." *See* 42 U.S.C. CAA section 7412(f)(2)(A).

Comment 19: Several commenters (19536, 19537, 19538) state that the EPA correctly interprets CAA section 112(n)(1)(A) to allow consideration of environmental effects in making an Appropriate and Necessary Finding. According to commenters, although CAA section 112 certainly allows the agency to find regulating EGUs is appropriate and necessary based on health or environmental findings, it does not require a "hazard" finding at all. Rather, state the commenters, it simply provides that the EPA must regulate EGUs if, after "considering" the Utility Study, it finds that doing so is appropriate

and necessary; thus, it leaves the agency broad discretion to make the appropriate and necessary finding so long as the agency has reasonably "consider[ed]" the results of the study. According to the commenters, the agency could have reasonably concluded that Congress wanted emissions of all listed HAP reduced by the maximum achievable degree, and thus regulation of EGUs which are the most significant emitter of virtually every HAP listed in CAA section 112(b) is both appropriate and necessary regardless of whether it was possible for the agency to fully assess all of the risks that toxic emissions from EGUs present.

Comment 20: Several commenters (19536, 19537, 19538) state where the CAA provides that EPA's action must be "based on" a study—more limiting language than the "considering" language found in CAA section 112(n)—the agency is not required to base its action exclusively on that study unless Congress has expressly stated so. *See Sierra Club v. EPA*, 325 F.3d374, 377 (D.C. Cir. 2003) (holding that CAA section 202(l) of the CAA -- which requires the EPA to conduct a "study of the need for, and feasibility of, controlling emissions of toxic air pollutants" and then requires the EPA to promulgate standards for mobile source air toxics "based on" that study—does not require that the standards be based exclusively on the required study).

Comment 21: Several commenters (19536, 19537, 19538) state that nowhere in CAA section 112(n)(1)(A) or elsewhere has Congress expressly stated, or even implied, that the EPA must base its Appropriate and Necessary Finding exclusively upon

the study prescribed in the first sentence of that CAA section. Moreover, state the commenters, the HAP emitted by EGUs are associated with adverse environmental impacts on wildlife, including endangered species, and ecosystem health. According to the commenters, the body of scientific evidence referenced in the preamble to the proposed rule clearly supports the agency's assessment and information provided by the commenter build on that scientific knowledge.

Comment 22: Several commenters (19536, 19537, 19538) state that the EPA's reliance on environmental effects as additional support for the finding that it is appropriate to regulate EGUs is supported by the rest of CAA section 112, which contains many examples of language evincing Congressional concern about the adverse environmental effects of HAP. For example, state the commenters, the EPA can add a substance to the list of HAP based solely on its adverse environmental effects. 42 U.S.C. CAA section 7412(b)(2)–(3) (authorizing the EPA to add a pollutant to the CAA

[Page 25]
section 112(b) list based on "a threat of adverse human health effects...or adverse environmental effects..."). Furthermore, state the commenters, an industry may be listed as containing major sources, and sources within that industry thus made subject to MACT regulation, based solely on HAP that have adverse effects on the environment. *See id.* CAA section 7412(b)(2).

Comment 23: Several commenters (19536, 19537, 19538) state that it would be unreasonable to assume

that Congress required the EPA to conduct an assessment of Hg's environmental effects under CAA section 112(n)(1)(B), but at the same time forbid the agency from considering these effects in its subsequent decision-making process.

Response to Comments 17 - 23: The EPA agrees with commenters that the Appropriate and Necessary Finding may be based on a finding that HAP emissions pose a hazard to public health or the environment. The EPA also agrees that it may consider information other than the Utility Study in making the appropriate and necessary determination. We further agree that it is reasonable to look to the definition of "adverse environmental effect" and the delisting criteria for guidance on determining whether HAP emissions from EGUs pose a hazard to public health or the environment.

b. Commenters disagreeing with the EPA's interpretation that 112(n)(1) allows consideration of both public health and environmental effects.

Comment 24: Several commenters (17716, 17731, 18803) state that the EPA erred by including environmental effects in the "appropriate" deliberations. These commenters do not agree with the EPA's position that "inclusion of environmental effects in CAA section 112(n)(1)(B) indicates Congress' interest in protecting the environment from HAP emissions." *Id.* at 24988/2. According to the commenters, the inclusion of "environmental effects" in subparagraph (b) of CAA section 112(n)(1) does not show an intent to incorporate by reference the same term "effects" in other subparagraphs. To

the contrary, state the commenters, when a term is included in one part of statute, but excluded in a different part, it is assumed Congress intended a differentiation. *E.g., Russello v. United States*, 464 U.S. 16, 23 (1983) ("'[W]here Congress includes particular language in one CAA section of a statute but omits it in another CAA section of the same Act, it is generally presumed that Congress acts intentionally and purposely in the disparate inclusion or exclusion.'") The commenters note that given that the disparate language is found in two subparagraphs of the same CAA section, the presumption is especially strong here.

Response to Comment 24: The EPA disagrees with the commenters for the reasons set forth in the preambles to the proposed rule and in this final action. Further, we do not think *Russello* in any way undermines our interpretation of CAA section 112(n)(1). Commenters have not explained why our interpretation of CAA section 112(n)(1) should be analogized to the statutory provisions of Organized Crime Control Act at issue in *Russello,* and we do not believe the comparison is reasonable or that the holding in that case is applicable to our interpretation of section 112(n)(1).

Comment 25: Commenter 17716 also states that further evidence of Congress' intended disparate treatment is found in the CAA section (n)(1)(B) limitation of considering environmental effects only of Hg emissions while under CAA section (n)(1)(A) all HAP emissions are to be studied.

Response to Comment 25: The EPA disagrees with commenter's characterization of the statute as

limiting the Agency to only considering hazards to public health, and we direct attention to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

[Page 26]
Comment 26: Commenters 17716 and 18502 disagree with the EPA's statement that CAA section 112(n)(1)(A) "is not written in a manner to preclude consideration of other information when determining whether it is appropriate and necessary to regulate EGUs under CAA section 112, and that includes consideration of all hazards, both health and environmental, posed by HAP emitted by EGUs," 76 FR 29488/3. According to the commenters, this position relies on the proposition that "'based upon' does not mean 'solely.'" The commenters note that the term "Based on" is not found in CAA section (n)(1)(A), thereby undercutting the proposition. The actual language of (n)(1)(A) refers to a finding made "after considering the results of the study required by this subparagraph." According to the commenters, the referenced study results did not include any environmental effects, demonstrating that they were not to be considered in the "appropriate" finding.

Response to Comment 26: The EPA disagrees with the commenters. We direct commenters to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 27: Commenter 17775 states that where Congress expected the EPA to take account of environmental effects in regulating under CAA

section112, it said so explicitly on the face of the statute. According to the commenter, in CAA section 112(n) Congress required that the EPA (i) "assess the hazards to public health and the environment resulting from the emission of hydrogen sulfide associated with the extraction of oil and natural gas resources;" and (ii) "study...the potential hazards of hydrofluoric acid...in industrial and commercial applications to public health and the environment." *See* CAA section 112(n)(5), (6).

Response to Comment 27: The EPA disagrees with the commenter. We direct the commenter to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment. Further, we disagree with commenter's implication that Congress did not specifically require consideration of environmental effects as evidenced by CAA section 112(n)(1)(B).

Comment 28: Commenters 17775 and 18023 state that the EPA has inherent discretion to consider "other information" that the agency may have derived from sources other than the Utility Study, including the Mercury Study and NAS Study[a] in making the "appropriate and necessary" finding. However, commenters state that the information that can be considered is limited to "hazards to public health" that are "reasonably anticipated to occur as a result of emissions by EGUs."

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[a] National Academies of Science(NAS). 2000. *Toxicological Effects of MeHg*. National Research Council. Washington, DC: National Academies Press.

Response to Comment 28: The EPA disagrees with the commenters. We direct commenters to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 29: Commenters 17775 and 18023 do not believe that the EPA explains how the language in subparagraph (n)(1)(B) to "consider the...environmental effects" of emissions from both EGUs and other sources authorizes the EPA to consider "environmental effects," and the effects of HAP emissions from non-EGU sources, in making its "appropriate and necessary" finding under subparagraph (n)(1)(A). According to the commenters, it is contrary to congressional intent to construe the provisions of subparagraphs (n)(1)(A), (B), and (C) to provide in their totality a framework for the Agency's determination of whether to regulate HAP emissions from EGUs under CAA section 112.

1 National Academies of Science(NAS). 2000. *Toxicological Effects of MeHg*. National Research Council. Washington, DC: National Academies Press.

[Page 27]
Response to Comment 29: The EPA disagrees with the commenters. We direct commenters to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 30: Commenter 18023 states that the EPA's interpretation allowing environmental impacts to be considered "flip-flops and rejects its

2004 interpretation" of the same provision. According to the commenter, by the EPA's logic they could consider any factors not expressly excluded from its consideration by Congress. The commenter notes that prior attempts to find statutory authority for such consideration absent an expressed congressional prohibition have been rejected by the courts and cites as an example *Ethyl v. EPA*, wherein the court stated, "To suggest, as the [agency] effectively does, that Chevron step two is implicated any time a statute does not expressly negate the existence of a claimed administrative power..., is both flatly unfaithful to the principles of administrative law...and refuted by precedent." *Ethyl Corp. v. EPA*, 51 F.3d1053, 1060 (D.C. Cir. 1995).

Response to Comment 30: The EPA disagrees with the commenter. We direct the commenter to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 31: Several commenters (17383, 17798, 17877, 17885, 17681) state that the CAA section 112(n)(1)(A) "necessary and appropriate" requirement is directed exclusively at EGU emission health hazards. Response to Comment 31: The EPA disagrees with the commenters. We direct commenters to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 32: Commenter 17608 states that the EPA's interpretations of the statute on the meaning of "appropriate" are inconsistent and unnecessarily limit the EPA's statutory discretion. According to the

commenter, the EPA argues that silence should be interpreted as a prohibition but then states that the term "appropriate" is extremely broad and nothing in the statute suggests that the agency should ignore environmental effects in determining whether to regulate EGUs under CAA section 112.

Response to Comment 32: The EPA disagrees with the commenter. We direct the commenter to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 33: Commenters 17731 and 18033 state the timing created by Congress in establishing the structure of CAA section 112(n)(1) shows an intent to base an "appropriate" finding solely on the hazards to the public health data that would have existed at the time the determination was to have been completed. The commenters state that the Utility Study ((n)(l)(A)) and the NAS Study ((n)(l)(C)) both were to be completed "within 3 years after November 15, 1990," and neither refers to environmental effects. In contrast, state the commenters, the Mercury Study ((n)(l)(B)) was to be completed "no later than 4 years after November 15, 1990" and was to consider environmental effects. According to the commenters, had the Utility Study and the NAS Study been completed in a timely fashion, neither would have had any environmental effects data. Consequently, such data would not have become available until a year later with the issuance of the Mercury Study. According to the commenters, Congress intended that the Administrator make an "appropriate" finding under (n)(l)(A) concurrently

[Page 28]
with issuance of the Utility Study and the NAS Study, or a year before any environmental effects data were available for consideration.

Response to Comment 33: The EPA disagrees with the commenters. We direct commenters to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment. In addition, we note that Congress did not provide a time limit on the appropriate and necessary determination as commenters suggest, except that the agency was constrained to wait until after the Utility Study was issued and considered. The CAA provided the agency the authority to make the appropriate and necessary determination based on the Utility Study alone if the facts warranted such action, and it also provided the agency with the flexibility to wait and consider all the information generated pursuant to CAA section 112(n)(1) and elsewhere if the agency determined it was appropriate to consider additional information. In fact, the EPA completed the Mercury Study prior to completing the Utility Study, notwithstanding the statutory mandates.

Comment 34: Commenter 17731 states that the EPA's view that if "Congress intended to prohibit EPA from considering adverse environmental effects in the 'appropriate' finding, it would have stated so expressly" stands administrative law on its head. According to the commenter, "EPA's view that it has inherent power to act unless Congress prohibits such action contravenes the fundamental principle that agencies are statutory creatures whose only powers

are those expressly delegated by Congress." *E.g., Louisiana PSC v. FCC*, 476 U.S. 355, 374 (1986) ("an agency literally has no power to act...unless and until Congress confers power on it"); *Bowen v. Georgetown Univ. Hospital*, 488 U.S. 204, 208 (1988) (same).

Response to Comment 34: The EPA disagrees with the commenter's conclusion as it relates to the EPA's interpretation of CAA section 112(n)(1) and we note that we did not determine it was reasonable to consider adverse environmental effects based only on the statement cited above by commenter. 76 FR 24988. We maintain that our interpretation of the statute is proper for the reasons set forth in the preambles to the proposed rule and this final action.

Comment 35: Several commenters (17731, 17716, 17834) state that the EPA takes inconsistent positions regarding how the statute should be interpreted. The commenters state that on one hand the EPA contends that the limited reference to "environmental effects of such [i.e., mercury] emissions" in (n)(l)(B) can be transformed into a general requirement that environmental effects of all HAP emissions can be considered under the (n)(l)(A) "appropriate" finding, while on the other hand, the EPA contends that costs cannot be considered in making that finding because "nowhere in CAA section 112(n)(l) does Congress require the consideration of costs in assessing health and environmental impacts. The commenters state that the only reference to costs is in CAA section 112(n)(l)(B) and that reference required the agency to consider the costs of emission reduction controls for Hg." 76 Fed Reg. at 24987. According to the

commenters, the only reference to "environmental effects" is in CAA section 112(n)(l)(B), and that reference requires the EPA to consider those effects only for Hg. Thus, the EPA's explanation does not justify treating costs one way (excluded) and environmental effects another way (included).

Comment 36: Commenter 17834 states that the EPA utilizes an illogical approach to the "appropriate and necessary" determination. On the same page of the proposed rule, states the commenter, the EPA first reasons that, with respect to CAA section 112(n)(1)(A), the absence of language expressly precluding the consideration of environmental effects provides the EPA with discretion to take such effects into account; however, the absence of language expressly authorizing the consideration of costs

[Page 29]
prohibits the EPA from taking costs into account. Regarding both environmental effects and costs, the EPA draws its authority, or lack thereof, from 112(n)(1)(B).

Response to Comments 35 and 36: Commenters are correct that CAA section 112(n)(1)(B) references both environmental effects and costs of controls, but we maintain it was reasonable to consider adverse environmental effects and not costs in determining whether it is appropriate and necessary to regulate HAP emissions from EGUs under CAA section 112. The agency is not required to and does not consider costs in any listing decisions and we maintain that approach is consistent with the purpose of CAA section 112. Congress also did not authorize the agency to consider costs in any delisting decisions.

On the other hand, protection of the environment is a goal of the CAA generally and CAA section 112 specifically, see CAA section 112(a)(7) ("defining adverse environmental effects"), such that it would be unreasonable to ignore environmental hazards associated with HAP emissions from EGUs when assessing whether to regulate EGUs under CAA section 112. Congress also specifically called for the EPA to assess environmental impacts in deciding whether to delist source categories and thus it is reasonable to consider such impacts in assessing whether to regulate EGUs under CAA section 112. Commenters do not and cannot state that the agency must consider costs in determining whether regulation of EGUs under CAA section 112 is appropriate and necessary, especially where, as here, hazards to public health and the environment are at issue.

Thus, although the EPA could have interpreted the term "appropriate" to allow for the consideration of costs, it reasonably declined to do so. Its approach is wholly consistent with the structure of CAA section 112, which does not contemplate consideration of costs in either listing or delisting decisions. Moreover, once listed, Congress precluded the agency from considering cost in setting MACT floors, which are technology-based standards. It is hard to imagine that Congress wanted the agency to consider costs in assessing whether to regulate EGUs, but then to ignore such costs in setting emission standards. We continue to believe that had Congress sought to require the consideration of costs in CAA section 112(n)(1)(A), it would have so stated.

Comment 37: Commenter 18033 states that the EPA's invocation of the U.S. Supreme Court's decision in *Massachusetts v. EPA* for the proposition that even if the benefits of regulating are negligible, the EPA still must promulgate standards under CAA section 112 is inapposite of the facts at issue in this rulemaking. According to the commenter, whereas in *Massachusetts* the Supreme Court rejected the EPA's use of "policy considerations" as a shield to deny a rulemaking petition urging the agency to regulate GHG emissions from new automobiles, the agency in this setting is attempting to use the very same "policy considerations" as a sword for regulating HAP emissions from EGUs. In rejecting the EPA's then-position, states the commenter, the Court emphasized that the agency may not rest its decision to regulate or not to regulate on "reasoning divorced from the statutory text."

Response to Comment 37: The EPA disagrees with the commenter's assertion that the agency does not have a reasoned basis under CAA section 112(n)(1) for regulating HAP emissions from EGUs. We maintain that the 2000 finding was reasonable at the time it was made based on the information available and our recent analyses confirm that it remains appropriate and necessary to regulate HAP emissions from EGUs.

Further, the agency cited *Massachusetts v. EPA* in relation to the necessary prong of the finding as support for our conclusion that we may find it necessary to regulate EGUs under CAA section 112 even if such regulation will not fully resolve the identified hazards. 76 FR 24991. Commenter has not

explained why the EPA was wrong to rely on *Massachusetts v. EPA* for support of that proposition.

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[Page 39]

a. Agreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis.

Comment 72: Several commenters (19536, 19537, 19538) state that the CAA makes clear that cost may not be considered at this stage. According to the commenters, the Supreme Court has held Congress has expressly granted authority to consider the costs of implementation only in circumstances that are specifically indicated. According to the commenters, that Congress has been so clear in those cases in which consideration of costs is allowed or required shows that implementation costs may not be relied upon by the EPA when making decisions under CAA sections that do not expressly provide for their consideration. *Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 467 (2001); *see also Am. Textile Mfrs. Inst. v. Donovan*, 452 U.S. 490, 510 (1981) (finding a general presumption in all statutes that "[w]hen Congress has intended that an agency engage in cost–benefit analysis, it has clearly indicated such intent on the face of the statute"). The commenters note that CAA section 112(n)(1)(A) only requires that the EPA "consider" the Utility Study in making its finding, and the Utility Study in turn is only required to cover "hazards to public health reasonably anticipated to occur." 42 U.S.C. CAA section 7412(n)(1)(A). According to the commenters, there is no statutory language or legislative history

that renders unlawful or arbitrary the EPA's conclusion that costs may not be considered when determining whether regulation of EGUs is appropriate and necessary.

Comment 73: Commenter 17648 states that the EPA rightfully excluded costs in assessing whether hazards to public health or the environment are reasonably anticipated to occur from HAP emissions from EGUs. According to the commenter, CAA section 112 does not permit the EPA to consider costs in deciding whether to list source categories for regulation under CAA section 112(c), in deciding whether to de-list source categories under CAA section 112(c)(9), or in setting MACT emission floors under CAA section 112(d)(3) for sources in listed source categories. The commenter states that even if it were appropriate to consider cost at the listing stage the Toxics Rule will produce annual benefits at least 7 to 17 times as great as any costs, and probably more.

Response to Comments 72 and 73: The EPA agrees that costs should not be considered when evaluating whether it is appropriate and necessary to regulate HAP emissions from EGUs as explained in the preamble to the proposed rule and response to comments set forth in the preamble to the final rule.

b. Disagreement with the EPA's interpretation that cost is not considered under the "appropriate" analysis.

Comment 74: Commenter 17775 does not agree with the EPA's interpretation that the term "appropriate" does not allow for consideration of cost.

Specifically the commenter finds the the EPA's reliance on the fact that under CAA section 112(c) Congress does not "permit the consideration of cost" to be misplaced. The commenter notes that while this may be true, given that Congress, through the mechanism of CAA section 112(n)(1), explicitly excluded EGUs from the automatic listing process of CAA section 112(c), the treatment of "costs" under CAA section 112(c) cannot support the agency's position under CAA section 112(n)(1). Similarly the commenter did not agree with the EPA's reliance on the delisting provisions under CAA section112(c)(9) where the EPA noted "Congress did not permit the consideration of costs in evaluating whether a source category could be delisted pursuant to the provisions of CAA section 112(c)(9)." 76 FR 24,989/1. The commenter states that the process by which sources may get "delisted" under CAA section 112(c)(9) sheds no light on the circumstances under which it may be "appropriate" to regulate EGUs in the first instance.

[Page 40]
Response to Comment 74: The EPA disagrees with the commenter. We direct the commenter to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 75: Commenter 17681 states that in determining whether regulation is "appropriate," the EPA concludes that it cannot consider costs. According to the commenter, this conclusion is contrary to the CAA.

Response to Comment 75: The EPA disagrees with the commenter. We direct the commenter to the

preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment.

Comment 76: Commenter 17775 states that CAA section 112(n)(1)(A) requires the EPA to "consider the results" of the Utility Study and in that study the agency is to "develop and describe...alternative control strategies" for those "emissions which may warrant regulation under this CAA section." According to the commenter, the cost of a given emission "control strategy" is a central factor in any evaluation of "alternative" controls therefore the EPA is expected to consider cost under CAA section 112(n)(1)(A).

Response to Comment 76: The EPA disagrees with the commenter. We direct the commenter to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment. We note specifically that the CAA does not require the EPA to consider the costs of alternative control strategies in the Utility Study and the EPA did not in fact consider such costs in that study.

Comment 77: Several commenters (17775, 17884, 18033, 18023) state that CAA regulatory provisions should be read with a presumption in favor of considering costs, with the D.C. Circuit having found that "[i]t is only where there is 'clear congressional intent to preclude consideration of cost' that we find agencies barred from considering costs." *Michigan v. EPA*, 213 F.3d 663, 678 (D.C. Cir. 2000) (quoting *NRDC v. EPA*, 824 F.2d 1146, 1163 (D.C. Cir. 1987)). According to the commenters, the legislative history

of CAA section 112(n)(1)(A) confirms that Congress intended the EPA to consider costs. *See* Oxley Statement at 1417 ("[T]he conference committee produced a utility air toxics provision that will provide ample protection of the public health while avoiding the imposition of excessive and unnecessary costs on residential, industrial and commercial consumers of electricity.").

Response to Comment 77: The EPA disagrees with the commenters. We direct commenters to the preamble to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment. The EPA did not conclude that we were absolutely precluded from considering costs, but instead that better reading of the statute is that the EPA may not consider costs when making the appropriate and necessary determination.

Comment 78: Commenter 17768 states that one of the factors that the EPA uses in determining whether or not to regulate EGUs is the availability of effective pollutant control technologies. The commenter notes that the availability and effectiveness of control technologies can be interpreted as "a sort of threshold-based consideration of costs" and therefore it is unclear that this part of the determination excludes the consideration of costs.

[Page 41]
Response to Comment 78: The EPA disagrees with the commenter. We direct the commenter to the proposed rule and responses to comments in the preamble to the final rule for responses to this

comment. Further, we specifically disagree that the availability of controls should be equated with a consideration of costs. The EPA did not issue many HAP regulations prior to the 1990 CAA amendments and it was unclear at that time how or if certain HAP, particularly Hg, could be controlled. Thus, we interpret the direction to consider available control technologies as an expression of Congressional interest in whether EGUs would be able to control HAP emissions from EGUs if such sources were regulated under CAA section 112.

Comment 79: Commenter 17768 states that the EPA should consider both costs and benefits more explicitly in the determination of appropriate. According to the commenter, in *Entergy v. Riverkeeper*, 129 S. Ct. 1498, 1509 (2009), the Supreme Court found that broad statutory language allows the EPA to weigh the social costs and benefits of regulation unless doing so is directly contrary to the statute.

Response to Comment 79: The EPA disagrees with the commenter. We direct the commenter to the proposed rule and responses to comments in the preamble to the final rule for responses to this comment. The EPA maintains that the better reading of the statute is that it does not allow the consideration of costs, and the statute does not require a consideration of costs.

Comment 80: Commenter 17768 states that because the proposed Utility MACT is expected to provide very significant benefits, and an interpretation of "appropriate" that incorporates cost-benefit analysis would clearly demonstrate that the agency is

following a reasonable regulatory path. According to the commenter, even if the current interpretation varies from the 2000 Finding, the current interpretation regarding cost, provided it is neither arbitrary nor capricious, is acceptable under *Chevron*. *See Nat'l Cable & Telecommunications Ass'n v. Brand X Internet Servs.*, 545 U.S. 967, 981 (2005) (discussing the deference provided to an Agency when changing interpretations the Court stated "change is not invalidating, since the whole point of Chevron deference is to leave the discretion provided by ambiguities of a statute with the implementing agency.")

Response to Comment 80: We agree that we reasonably declined to consider costs in evaluating whether it is appropriate and necessary to regulate EGUs under CAA section 112.

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[Page 52]

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c. Agreement that EGUs were properly listed under CAA section 112(c)(1) and may not be delisted because they do not meet the delisting criteria in CAA section 112(c)(9).

Comment 121: Commenter 17648 states that it is reasonable for the EPA to look to the de-listing criteria in CAA section 112(c)(9) as a basis for evaluating the hazards that warrant regulating HAP emissions from EGUs. According to the commenter, any health hazard greater than the criteria set out in the de-listing criteria is an appropriate basis for

determining that there exists a hazard to public health fi om EGU emissions.

Comment 122: Commenter 17620 notes that the Court concluded that, having determined in 2000 that regulation ofEGUs was necessary and appropriate, the only procedure available to the EPA to reverse that decision is delisting under CAA section 112(c)(9)(B). According to the commenter, that CAA section requires a demonstration that no source in the category emits carcinogens at a level that would increase the cancer risk to the most exposed population by more than one in one million, that no source in the category emits at a level that exceeds that needed to protect public health with an adequate margin of safety and that there will be no adverse environmental impact from the source's emissions. The commenter notes that no such showing has been made or attempted.

Comment 123: Commenter 17768 believes that EGUs were properly listed under CAA section 112(c)(l) and do not meet the delisting criteria in CAA section 112(c)(9). According to the commenter, the "necessary after imposition of the requirements of the CAA" prong of the "appropriate and necessary" determination raises the issue of the appropriate regulatory baseline to use in evaluating the effects of a regulation. However, states the commenter, in the context of regulating electric generating units under CAA section 112, the benefits of regulation are so great that the regulatory baseline issue is not significant. The commenter notes that combined appropriate and necessary standard only occurs in sub-CAA sections (m) (Great Lakes HAP deposition

provision) and (n) (EGUs provision) ofCAA section 112. The commenter states that this determination does, however, highlight the importance of

[Page 53]
the EPA's interpretation ofthe statutory term "appropriate." The commenter states that the EPA should revise the way in which it makes this determination.

Comment 124: Several commenters (19536, 19537, 19538) state that following the 2005 delisting, states, tribes, and environmental and public health groups challenged the EPA's 2005 Delisting rule and CAMR in the D.C. Circuit as unlawful and arbitrary and capricious. *New Jersey v. EPA,* 517 F.3d 574, 582-83 (D.C. Cir. 2008). The commenters state that although the EPA admitted that it had listed EGUs in 2000 and that this listing otherwise would require the agency to set MACT standards for EGUs, the agency claimed wrongly that it had authority to de list EGUs at any time just by reversing the Appropriate and Necessary Finding and without making the delisting showing required by CAA section 112(c)(9). *Id.* at 580; *see also* 70 FR 16,032. The D.C. Circuit disagreed. The Court stated that the plain text ofCAA section 112(c)(9) "governs the removal of any source category from the CAA section 112(c)(l) list, and nothing in the [Clean Air Act] exempts EGUs from CAA section 112(c)(9)." *New Jersey v. EPA,* 517 F .3d at 582. Accordingly, state the commenters, the Court held that the EPA could not delist EGUs and avoid regulation without first satisfYing the requirements ofCAA section 112(c)(9). *Id.* According to the commenters, because the EPA conceded that it

never made the findings required to satisfy CAA section 112(c)(9), the Court held that the delisting was flatly unlawful and that EGUs remained listed and subject to MACT regulation under CAA section 112(c).

Comment 125: Commenter 17648 states that having made the Appropriate and Necessary Finding and listed EGUs as a source category under CAA section 112(c), the only way the agency could possibly avoid promulgating regulations is to make the showing required by CAA section 112(c)(9) to de-list EGUs. The commenter goes on to note that after *New Jersey,* the de-listing criteria provide the minimum standards for declining to regulate EGUs *(New Jersey v. EPA,* 517 F.3d at 582-83). That is, the Court's decision in *New Jersey* implies that it must be necessary and appropriate to regulate EGUs if the EPA cannot meet the standard for de-listing set forth in CAA section 112(c)(9). The commenter states that when objectors attempted to challenge the 2000 Finding, their appeal was dismissed as unripe and the Court held that the decision to list could only be challenged in the context of a challenge to the promulgation of a NESHAP. *(Utility Air Regulatory Group v. EPA,* 2001 WL 936363, No. 01-1074 (D.C. Cir. July 26, 2001). According to the commenter, the EPA's decision in 2005 to reconsider the 2000 Finding and listing and to delist EGUs was effectively a voluntary decision by the EPA to reconsider its earlier determination, rather than to wait for a judicial challenge and a remand. According to the commenter, the Court's decision in *New Jersey* invalidating that action and determining that the de-listing criteria in CAA section 112(c) govern the

agency's voluntary reconsideration of its listing decision necessarily means that it must be proper for EPA to have listed EGUs if it could not de-list them. If a court determines otherwise, states the commenter, then a litigant may be able to invalidate the EPA's determination through the comis more easily than the EPA itself could reconsider its own decision.

Commenter 17648 goes on to note that, therefore, before the EPA could decline to promulgate the Toxics Rule, at a minimum the agency would need to demonstrate that (1) no carcinogenic HAP is emitted from any EGU in quantities that may cause a lifetime risk of cancer of greater than one in one million in the most exposed individual, and (2) that no HAP is emitted from any EGU at a level exceeding that adequate (a) to protect public health with an ample margin of safety or (b) to assure no adverse environmental effect. *See* 42 U.S.C. CAA section 7412(c)(9)(B). Scientifically, states the commenter, the EPA cannot do this; the Utility Study showed that HAP emissions from several EGUs cause a lifetime cancer risk greater than one in one million. Further, states the commenter, the EPA's recent case studies on data collected for the Toxics Rule reflect that at least four EGUs present a lifetime

[Page 54]
cancer risk in excess of one in one million. As a result, the commenter concludes that even without considering the adverse environmental effects and non-cancer health risks from EGU HAP emissions, the EPA must promulgate the Taxies Rule.

Response to Comments 121 -125: The EPA agrees that EGUs were properly listed and that the agency may not remove them from the CAA section 112(c) list without complying with the delisting provisions ofCAA section 112(c)(9). The EPA also agrees with the commenters that state the delisting provisions provide a reasonable guide for determining whether HAP emissions from EGUs pose a hazard to public health or the environment. We decline to revise our interpretation of the term "appropriate" as suggested by one commenter.

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[Page 55]

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9. Consideration of criteria pollutants under Appropriate and Necessary Finding.

Commenters: 17383, 17608, 17620, 17656, 17689, 17696, 17712, 17716, 17723, 17724, 17725, 17731, 17753, 17754, 17771, 17805, 17813, 17820, 17838, 17842, 17868, 17876, 17884, 17885, 17886, 18014, 18024, 18034, 18428, 18443, 18488, 18498, 18500, 19114, 19506, 18023

[Page 56]

Comment 130: Several commenters (17724, 17731, 17876) state that rather than following the requirements of the CAA, the EPA used PM emissions from all sources to justify MACT controls and to show an economic benefit under the cost benefit analysis under CAA section 112(d)(2). The commenters state that no pollutant may be added to the HAP list under CAA section 108 unless the

pollutant independently meets the listing criteria in CAA section 112 or is in a class of pollutants listed under CAA section 112. According to the commenters, while Congress added a technology-based component to HAP regulation in 1990, it did not abandon the chemical-by-chemical risk-based approach of listing and delisting particular chemicals, nor did it abandon regulating HAP based upon carcinogenic and other adverse impacts as defined in CAA section 112(b)(2). According to the commenters, PM, in general, does not independently meet the listing criteria of CAA section 112(b). As such, according to the commenters, the EPA's attempt in the preambles to the proposed rule to regulate PM as an individual HAP must fail for lack of statutory authority to do so.

Response to Comment 130: The EPA did not regulate PM as a HAP in the proposed rule. Instead, PM is a surrogate for non-Hg metallic HAP. The EPA is authorized to establish surrogate standards for HAP emissions as long as the surrogate is reasonable. *See Sierra Club v. EPA*, 353 F.3d 976, 984-985 (D.C. Cir. 2003).

Comment 131: Multiple commenters (17656, 17696, 17754, 17771, 17805, 17731, 17868, 17723, 17813, 17886, 18428, 18498, 18024,17753, 17838) state that the EPA's substantial reliance on the projected co-benefits of controlling PM2.5 and other non-HAP emissions to support the proposed MACT is inconsistent with CAA section 112 in that criteria pollutants are subject to regulations under the NAAQS.

Response to Comment 131: The EPA did not rely on co-benefit reductions to support the Appropriate and Necessary Finding as commenters suggest.

Comment 132: Commenter 18488 states that the CAA section 110 process described in the CAA has been the anchor of air quality management since the promulgation of the CAA Amendments of 1970 and, based on the dramatic improvement in air quality since 1970, has worked well for more than 40 years. According to the commenter, the proposed rule is inconsistent with the CAA section 110 process since it would utilize CAA section 112 MACT controls for the purpose of reducing emissions of PM2.5, which is a criteria pollutant.

Response to Comment 132: The EPA disagrees with the commenter that this rule is inconsistent with CAA section 110. The EPA determined that PM is a viable surrogate for non-Hg metallic HAP. The EPA is authorized to establish surrogate standards for HAP emissions as long as the surrogate is reasonable. *See Sierra Club v. EPA*, 353 F.3d 976, 984-985 (D.C. Cir. 2003).

Comment 133: Commenter 18034 states that regulating total PM under CAA section 112 as a surrogate for HAP metals is circumventing the CAA's structure of cooperative federalism, which gives states the authority to regulate criteria pollutants under the NAAQS program in a flexible manner taking into account local needs and state prerogatives. The commenter states that the state's participation in the regulation of total PM under CAA section 112 is essentially limited to a notice and comment opportunity, where as the states' role in the

regulation of total PM under CAA section 108(a) is a much broader cooperative partnership between the EPA and states which includes preparation of state implementation plans (SIP) and the solicitation of greater public participation. According to the commenter, the effect of regulating total PM through CAA section 112 for EGUs instead of regulating it

[Page 57]
through the NAAQS program deprives states of their lawful authority to regulate PM emissions as a cooperative partner with the EPA through their SIPs and "to make the many sensitive technical and political choices that a pollution control regime demands." *NRDC v. Browner*, 57 F.3d 1122, 1124 (D.C. Cir. 1995).

Response to Comment 133: The EPA disagrees with the commenter that this rule is inconsistent with CAA section 108. The EPA determined that PM is a viable surrogate for non-Hg metallic HAP. The EPA is authorized to establish surrogate standards for HAP emissions as long as the surrogate is reasonable. *See Sierra Club v. EPA*, 353 F.3d 976, 984-985 (D.C. Cir. 2003).

Comment 134: Commenter 17716 states that "other benefits and co-benefits" cannot be used to support the rule. According to the commenter, the stated objectives for imposing MACT regulation (retire old units/criteria pollutant co-benefits) do not match what Congress intended under CAA section 112(n)(1), which is to protect the public health from EGU HAP emissions that create a risk. Absent this finding the commenter believes the EPA relied on

other benefits and co-benefits to support the proposed rule.

Response to Comment 134: The EPA did not rely on co-benefit reductions to support the Appropriate and Necessary Finding. The commenter is confusing likely outcomes of the rule, such as retirement of older units and criteria pollutant co-benefits, with the basis for the rule, identified hazards to public health and the environment that will not be addressed through imposition of the requirements of the CAA.

Comment 135: Commenter 17724 does not object to the use of surrogates to measure compliance with HAP standards when the presence of the HAP in the flue gas stream is too small to be accurately measured by existing monitors. However, the commenter notes that it does not follow that the surrogates can be substituted for the HAP in determining risk-based HAP standards for each HAP, or the technology-based MACT for each category or subcategory of sources covered by the MACT.

Response to Comment 135: The EPA disagrees that there are not measurement methodologies available to measure Hg, non-Hg metallic HAP, and acid gas HAP. The EPA also disagrees with the commenter that we are not authorized to set surrogate standards. The EPA determined that PM is a viable surrogate for non-Hg metallic HAP. The EPA is authorized to establish surrogate standards for HAP emissions as long as the surrogate is reasonable. *See Sierra Club v. EPA*, 353 F.3d 976, 984-985 (D.C. Cir. 2003).

Comment 136: Several commenters (17608, 19114, 17820, 18443, 19114) state that because much of the public health and environmental benefits to this rule are derived from limits on criteria pollutants, the EPA could assert that regulation of HAP other than Hgis not appropriate.

Response to Comment 136: We do not agree that the existence of criteria pollutant co-benefits provides a justification for not regulating EGUs consistent with the provisions of CAA section 112(d).

Comment 137: Several commenters (17689, 17383, 17712, 17885, 18443) state that the EPA seems to believe that regulating EGU emissions under CAA section 112(c) and (d) is justified because existing emissions control technologies such as FGD systems, SCR systems, fabric Filters, ESPs and wet ESPs are all demonstrated technologies for controlling PM2.5 emissions, acid gases, and in many cases Hg. According to the commenters, this is precisely a reason not to regulate under CAA section 112 as there are many programs already regulating particulate.

[Page 58]
Response to Comment 137: The EPA disagrees with the commenters' conclusion. The EPA reasonably considered the availability of controls for HAP emissions from EGUs in evaluating whether regulation of such units is appropriate and necessary.

Comment 138: Several commenters (17842, 17725, 18500, 19114) state that the ultimate goal of CAA section 112 is to reduce Hg emissions from EGUs.

However, state the commenters, the proposed rule relies "overwhelmingly" on PM-related benefits to justify its costs. According to the commenters, the EPA estimates that only $450,000 to $5.9 million of proposed rule's estimated benefits are attributed to Hg reductions, while $53 to $140 billion may be derived from PM reductions.

Response to Comment 138: The EPA is not required to, and did not, justify costs before listing EGUs under CAA section 112 as the commenter suggests. We also disagree with commenters' characterization of the goal of the rule.

Comment 139: Commenter 19506 states that the rule should be reconsidered under the absurd results doctrine that the EPA used to justify the applicability thresholds in the Tailoring Rule. According to the commenter, the base case scenario used in the model run included state Hg regulations and voluntary emission reduction programs and the co-benefits for PM2.5 can be attributed in part to the PM2.5 NAAQS, the Clean Air Interstate Rule and the Regional Haze Program. The commenter states that if the calculated annual Hg reduction benefits from this proposed regulation (the only identified HAP reduction benefits) of $5,000 to $6,000,000 per year are compared to the estimated annual rule cost of $10,900,000,000, this rule requires U.S. society to spend between $1,211 and $2,180,000 per dollar of mercury reduction benefit.

Response to Comment 139: The EPA is not required to consider benefits when determining whether to list and regulate HAP emissions from EGUs under CAA section 112. The EPA does not

agree with commenters' that the regulation of EGUs under CAA section 112 leads to an absurd result because the primary quantifiable benefits of the rule stem from co-benefit reductions.

Comment 140: Commenter 17884 states that the EPA lacks authority to adopt a rule under CAA section 112, the section of the CAA addressing HAP, in order to reduce SO2. According to the commenter, the EPA has not been able to quantify any benefit from reducing acid gas emissions, thus the EPA is regulating acid gas emissions without being able to show any benefit from doing so in order to regulate SO2 emissions, which it has no authority to do under CAA section 112.

Response to Comment 140: The EPA is not required to consider benefits when determining whether to list and regulate HAP emissions from EGUs under CAA section 112.

Comment 141: Commenter 18014 states that the presumed co-benefits from PM and acid gas reductions should not be part of the "appropriate and necessary" determination. According to the commenter, the EPA's logic that "although NESHAP may directly address only HAP, not criteria pollutants, Congress did recognize, in the legislative history to CAA section 112(d)(4), that NESHAP would have the collateral benefit of controlling criteria pollutants as well and viewed this as an important benefit of the air toxics program" seems "backward." The commenter notes that NESHAP rules are intended to address HAP and Congress simply acknowledged that by addressing the HAP issues there would be coincidental reductions in

other emissions. The commenter states that the EPA's objective "seems aimed at the 'collateral benefits.'"

[Page 59]
Response to Comment 141: The EPA disagrees with the commenter. The EPA's appropriate and necessary determination does not rely on co-benefit reductions of criteria pollutants. Commenter is also wrong that the agency's objective was to obtain criteria pollutant co-benefits.

Comment 142: Commenter 18023 states the EPA "purports" to find authority to consider criteria pollutants in reading of the legislative history of the Senate Bill, S. 1630. According to the commenter, the Administrator's reliance on reduction of SO2 emissions and the associated reduction in ambient PM concentrations, however, is in conflict with the statute itself. The commenter states that CAA section 109(b)(1) directs the Administrator to establish NAAQS at levels "requisite to protect the public health" with "an adequate margin of safety," And similarly, CAA section 109(b)(2) directs her to establish secondary standards "requisite to protect the public welfare from any known or anticipated adverse effects associated with the presence of such air pollutant in the ambient air." According to the commenter, the Supreme Court held that requisite means "sufficient, but not more than necessary." *Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 475–76 (2001). If changes to ambient levels of SO2 and PM are "requisite" to protect public health, states the commenter, those changes should be required under the NAAQS established under CAA section 109 and

achieved through the state implementation plan process of CAA section 110. If, on the other hand, these changes to ambient levels of SO2 and PM are not requisite to protect public health, states the commenter, those changes are "more than necessary." According to the commenter, reliance on those changes as a basis for additional emission regulations conflicts with the statutory mandate of CAA section 109. In either case, states the commenter, the reliance on such changes as a basis for implementing CAA section 112(d)(4) is inappropriate and inconsistent with CAA section 109.

Response to Comment 142: The EPA's appropriate and necessary determination does not rely on cobenefit reductions of criteria pollutants.

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[Page 77]
Response to Comments 1 - 3: The EPA agrees that the new technical analyses (e.g., the risk assessments and the technology assessment) confirm the 2000 Appropriate and Necessary Finding. The Hg Risk TSD was peer reviewed by the EPA's independent Science Advisory Board (SAB) during the public comment period, and the panel assigned to review the assessment concluded "the design of the risk assessment [w]as suitable for its intended purpose, to inform a decision-making regarding an "appropriate and necessary finding" for regulation ofHAP from coal- and oil-fired EGUs" (U.S. EPASAB,

2011[3] The risk assessment methodology for the non-Hg case studies was consistent with the methodology that the EPA uses for assessments performed for Risk and Technology Review rulemakings, which underwent peer review by the SAB in 2009[4]. During the public comment period, the EPA also completed a letter peer review of the methods used to develop inhalation cancer risk estimates for Cr and nickel compounds, and those reviews were supportive. The EPA revised both TSDs documenting the two risk assessments consistent with recommendations fi om the peer reviewers as part ofthe final rulemaking and has made those revised TSDs available in the rule docket. Although these new analyses were not required, the EPA agrees that it was authorized to conduct additional analyses to confirm the 2000 Finding. The EPA also agrees with the commenters that the 2000 Finding was valid at the time it was made based on the CAA section 112(n)(l) studies and

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[3] U.S. Environmental Protection Agency- Science Advisory Board (U.S. EPA-SAB). 2011. Peer Review of EPA's Draft National-Scale Mercury Risk Assessment. The EPA-SAB-11-017. September.

Available on the internet at

http://yosemite.epa.gov/sab/sabproduct.nsf/BCA23C5B7917F5BF_8525791_A0072CCA_1_/$File/EPASAB-11-0_17-unsigned.pdf.

[4] U.S. Environmental Protection Agency- Science Advisory Board (U.S. EPA-SAB). 2010. *Review of EPA's draft entitled, "Risk and Technology Review (RTR) Risk Assessment Methodologies: For Review by EPA's Science Advisory Board with Case Studies- MACT I Petroleum Refining Sources and Portland Cement Manifacturing". The EPA*-SAB-10-007. May. Available on-line at:

http://yosemite.epa.gov/sab/sabproduct.nsf/4AB3966E263D943A8525771F00668381/$File/EPA-SAB-1 0-007-unsigned.pdf

other information available to the agency at that time. The public has been provided a fair opportunity to evaluate both the 2000 Finding and the new assessment, each of which independently support the listing of coal- and oil-fired EGUs.

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[Page 79]

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Comment 9: Commenters 17712 and 18443 state that for acid gases, especially HCl and HF, the EPA identified no study or rational basis to demonstrate concrete health concerns associated with these types of emissions. According to the commenters, the fact that the EPA Administrator "remains concerned" about potential effects of these acid gases falls far short of any reasonable appropriate and necessary basis to regulate them under CAA section 112. The commenters state that for non-Hg HAP, the EPA produced one study on chronic inhalation risk assessment that identified three sites with cancer risks greater that one in one million for hexavalent Cr; the study was authored by EPA staff, has not been peer reviewed, and raised numerous critical issues fundamental to its validity. For example, state the commenters, surrogate speciated Cr emissions data were used at the study sites instead of actual emissions information, emissions factors were derived where site unit data was unavailable, in some cases the units were assumed to run 100% of the time which is impossible, dispersion modeling was used that is biased towards over-predicting downwind impacts, and estimated ambient concentrations were utilized as substitutes for real

exposure concentrations for all people within a census block. In short, state the commenters, the study was nothing more than a rough synthetic attempt at ascertaining the EPA-desired individual risk information.

Commenter 17712 concludes that the EPA's conclusions appear inconsistent with other research efforts and are highly suspect, especially considering the study's shortfalls as cited above. Even if taken as accurate representation, the commenter believes the results hardly demonstrate that it is necessary and appropriate to regulate HAP emissions from coal-fired U.S. EGUs under CAA section 112 because three sites nation-wide show risks greater that one in one million with the highest at eight in one million.

Response to Comment 9: The commenter makes much of the fact that the EPA identified at proposal only three coal-fired EGU facilities that had a maximum cancer risk greater than 1 in a million, the level below which sources may petition to delist under CAA section 112(c)(9)(B)(i), but the commenter fails to note that the finding was based on an analysis of only sixteen case study facilities and the total number of facilities with risks greater than 1 in a million was four. Furthermore, an additional four of the

[Page 80]
16 case study facilities showed maximum cancer risks equal to 1 in a million. In these assessments, the EPA only quantified the risk attributable to the EGU facility itself without considering the location of the facility and the other HAP-emitting facilities

that may be located in sufficiently close proximity to exacerbate the cancer risks for the exposed population. Cumulative HAP inhalation risks for the population near these facilities could be substantially greater. As stated at proposal, the EPA concludes it is unreasonable and unrealistic to view HAP emissions from U.S. EGUs emissions as if they occur in a bubble because that is not the manner in which the public is exposed to HAP emissions. In sum, the EPA maintains that the level of risk from non-Hg metallic HAP from U.S. EGUs alone makes it appropriate and necessary to regulate such sources under CAA section 112(d) and that is before even considering the total HAP risk for affected populations. This determination is consistent with the valid interpretation of CAA section 112(n)(1) set forth in the preamble to the proposed rule.

Concerning the acid gas HAP, the EPA disagrees with the notion that each HAP emitted by U.S. EGUs requires its own separate Appropriate and Necessary Finding. Furthermore, in the inhalation case studies, the EPA was only able to quantify the portion of the acid gas risks that might be attributable to hydrogen chloride and HF emissions. While these estimated risks (which are associated with chronic non-cancer impacts, but not cancer) by themselves were not very high, the EPA noted that they carry the potential to combine with other respiratory irritants from other nearby sources to create cumulative exposures of concern to nearby residents. The EPA also noted the sheer tonnage of HCl emitted by all EGUs nationally as a potential concern, as there was the potential for these emissions to acidify natural environments.

Additionally, the EPA was not able to get quantitative emission information about the other acid gases (including chlorine and HCN), some of which are more potent respiratory irritants than HCl. As a result, the EPA continues to be concerned about the potential impacts of acid gas emissions from U.S. EGUs.

The EPA disagrees that the case study analysis for non-Hg HAP is not valid. The EPA's dispersion modeling of the case study facilities was performed consistent with EPA's Guideline on Air Quality Models,[5] and used:

1) 5 years of recent meteorological data from the weather station nearest to each facility, rather than 1 year of meteorological data. This is more representative of long-term (i.e., lifetime) exposures and risks.

2) Temporally-varying emissions based on continuous emissions monitoring data, rather than assuming a constant emission rate for each facility throughout the entire simulation.

3) Building downwash, where appropriate.

4) The latest version of AERMOD [version 11103]

The EPA's assessment of the case study facilities for the proposed rule concluded that, out of the 16 case studies, three coal-fired facilities and one oil-fired facility had estimated lifetime cancer risks greater than one in a million. For the final rule, revisions

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[5] Appendix W to 40 CFR 51

were made to the 16 case studies partly based on comments received, and the results indicate that five coal-fired facilities and one oil-fired facility had estimated lifetime cancer risks greater than one in a million.

Regarding peer review, the risk assessment methodology for the case studies was consistent with the methodology that the EPA uses for assessments performed for Risk and Technology Review rulemakings, which underwent peer review by the SAB in 2009. Also, in July 2011, the EPA completed

[Page 81]
a letter peer review of the methods used to develop inhalation cancer risk estimates for Cr and nickel compounds, and the reviews were supportive. The EPA also disagrees that units were assumed to operate 100% of the time. The dispersion modeling performed for the case study facilities used hourly heat input as a temporalization factor for estimating hourly emissions, and in some cases hourly heat inputs (and emissions) were zero or very low.

The EPA disagrees with the commenters' assertion that "real exposure concentrations for all people within a census block" must be considered because it runs counter to the long-standing approach that the EPA took to estimate the maximum individual risk (MIR). The MIR is defined by EPA's Benzene NESHAP regulation of 1989 and codified by CAA 112(f) as the lifetime risk for a person located at the site of maximum exposure 24 hours a day, 365 days a year for 70 years (e.g., census block centroids). 54 FR 38044. The MIR is the risk metric associated with the determination of whether or not a source

category may be delisted from regulatory consideration under CAA section 112 (112(c)(9)). The MIR is the risk metric used to characterize the inhalation cancer risks associated with the case study facilities. To evaluate the MIR, the EPA used the estimated annual average ambient air concentration of each HAP at each census block centroid as a surrogate for the lifetime inhalation exposure concentration of all the people who reside in that census block. The EPA used this approach to estimate MIR values in all of its risk assessments to support risk-based determinations and rulemakings under CAA section 112 of the CAA to date.

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[Page 435]

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Comment 30: Several commenters (17705, 17712, 18443) state that the MACT floor for existing sources should be based on the best performing 12% of existing sources for all HAP. In determining the EGU MACT limits, the EPA derived the MACT floor by aggregating all1091 coal-fired EGU's regardless of type of boiler or fuel and establishing the best performing 12% for each HAP category from the 1091. CAA section 112(d) requires that the EPA set this MACT floor using the best performing 12% for each category or subcategory ofunits with 30 or more sources. Ifthe EPA followed the statute in setting the EGU MACT floors, 130 sources should be able to comply with all the proposed standards as they operate today. This is not the case. Currently, no coal-fired unit tested in the ICR will meet the limits that the EPA is proposing. The EPA has

misinterpreted the CAA by proposing a MACT floor that is based on the best performing 12% of all coal-fired EGUs for each HAP, rather than the best performing 12% coal-fired EGUs in each subcategory for all regulated HAP. The EPA should redefine the EGU fleet and propose standards achieved on average by the 12% best performing sources for all HAP in each category.

Response to Comment 30: We address the comments opposed to the pollutant-by-pollutant approach above and in the preamble to the final rule. Further, the EPA disagrees with commenter's assertion that a plain reading ofthe statute would indicate that 12% of the population should be meeting the limits. In fact, the statute does not require that the existing source standard be achievable for any source in the category. In any case, however, the commenter is incorrect because the average of the best 12% would not be 12% but instead would be 6%. In this rule, based on the data available, we have identified approximately 69 coal-fired units meeting all the standards and that accounts for approximately 6% of the coal-fired EGU population.

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EPA's Responses to Public Comments on EPA's *National Emission Standards for Hazardous Air Pollutants from Coal- and Oil-Fired Electric Utility Steam Generating Units*

December 2011

Volume 2 of 2

Comments, letters, and transcripts of the public hearings are also available electronically through *http://www.regulations.gov* by searching Docket ID *EPA-HQ-OAR-2009-0234.*

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[Page 322]

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Response to Comments 49-50: In both the preamble to the rule and in greater detail in the TSD, the EPA has assessed the feasibility of installing these controls within the compliance window and believes that the controls can be reasonably installed within that time. Although the EPA assessed the ability to install the controls in 3 years (and determined that the controls could be installed in that time-frame), this would require the control technology industry to ramp up quickly. Therefore, the EPA also assessed a time-frame that would allow some installations to take up to 4 years. This time-frame is consistent with the CAA which allows permitting authorities the discretion to grant extensions to the compliance time-line of up to 1 year. This time-frame also allows for staggered

installation of controls at facilities that need to install technologies on multiple units. Staggered installation allows companies to address such issues as scheduling outages at different units so that reliable power can be provided during these outage periods or particularly complex retrofits (e.g., when controls for one unit need to be located in an open area needed to construct controls on another unit). In other words, the additional 1-year extension would provide an additional two shoulder periods to schedule outages. It also provides additional opportunity to spread complex outages over multiple outage periods. The EPA believes that while many units will be able to fully comply within 3 years, the 4th year that permitting authorities are allowed to grant for installation of controls is an important flexibility that will address situations where an extra year is necessary. The EPA expects that state permitting authorities will make the fourth year available where it is warranted. In addition where necessary to avoid a violation of applicable PERC-approved electric reliability standards the EPA can use existing CAA authorities to allow additional time to come into compliance.

Comment 51: Multiple commenters (8443, 17123, 17297, 17406, 17623, 17716, 17732, 17756, 17716, 17752,17758,17820,17842,17912,18024,18419,18422, 18440,18502, 19121) are concerned about financing these projects and the likely cost increases for labor and equipment likely to occur over this compliance period.

[Page 328]

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Response to Comments 52-62: The EPA has considered the concerns raised by commenters and has concluded that given the flexibilities provided in the final rule, the requirements ofthe final rule for existing sources can be met by most sources without adversely impacting electric reliability. In particular, the EPA believes that the flexibility of permitting authorities to allow a fourth year for compliance should be available in a broad range of situations (as discussed below), and that this flexibility addresses many ofthe concerns that have been raised. Furthermore as indicated below, in the event that an isolated, localized concern were to emerge that could not be addressed solely through the 1-year extension under CAA section 112(i)(3), the CAA provides flexibilities to bring sources into compliance while maintaining reliability.

[Page 329]

The EPA considered the impact that potential retirements in response to this rule will have on resource adequacy. In considering these impacts, the EPA considered both the analysis it has conducted as well as analyses conducted by a number of other groups. The EPA's analysis shows that the expected retirements of coal-fueled units as a result ofthis final rule (4.7 GW) are fewer than was estimated at proposal and much fewer than some have predicted. Because concerns have been raised that the use of DSI may not be as prevalent as the agency has predicted and because this could lead to more coal retirements, the agency also performed a sensitivity

analysis in which less DSI systems and more scrubber systems were installed. In that sensitivity, we see approximately 1 more GW of retirement. This small change would have only a very small potential impact on reliability. When considering the impact that one specific action has on power plant retirements, it is important to understand that the economics that drive retirements are based on multiple factors including: expected demand for electricity, the cost of alternative generation, and the cost of continuing to generate using an existing unit. e EPA's assessment looked at the capacity reserve margins in each of32 sub-regions in the continental U.S. Demand forecasts used were based on EIA projected demand growth. The analysis shows that with the addition of very little new capacity, average reserve margins are significantly higher than required. The NERC assumes a default reserve margin of 15 percent while the average capacity margin seen after implementation of the policy is nearly 25 percent. Although such an analysis does not address the potential for more localized reliability concerns associated with transmission constraints or the provision oflocation-specific ancillary services (such as voltage support and black start service), the number of retirements projected suggests that the magnitude of any local reliability concerns should be manageable with existing tools and processes.

Several outside analyses have reached conclusions consistent with EPA's analysis. The DOE, in December 2011, published a report that looked at resource adequacy in the bulk power system when faced with a stress test which was a regulatory

scenario far more stringent than EPA's regulations.[10] For this stress test, in addition to CSAPR and MATS requirements, each uncontrolled electric generator is required to install both a wet FGD system and a fabric filter to reduce air taxies emissions. If such installations are not economically justified, this scenario assumes that the plant must retire by 2015. In reality, as discussed previously, power plant owners will have multiple other technology options to comply with the regulations- options that typically cost less than installations ofFGDs and fabric filters. The analysis finds that target reserve margins can be met in all regions, even under these stringent assumptions. Moreover, in every region but one (TRE), no additional new capacity is needed. In TRE, the analysis finds that less than 1 GW of new natural gas capacity would be needed by 2015 beyond the additions already projected to occur in the Reference Case. This analysis also finds that the total amount of new capacity that would be added by 2015 is less than the amount that is already under development.

In August 2011, PJM Interconnection- the Regional Transmission Operator (RTO) responsible for planning and reliable operation of the bulk power system serving all or portions of 13 states in the MidAtlantic and Midwestem regions- issued a report analyzing the impacts of tbe CSAPR and the proposed MATS rule.[11] Although PJM's analysis

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[10] U.S. Department of Energy, December 2011, "Resource Adequacy Implications of Forthcoming EPA Air Quality Regulations".

[11] PJM Interconnection, August 26,2011, "Coal Capacity at Risk for Retirement in PJM: Potential Impacts of the Finalized

assumes substantially more retirements than EPA projects, it nevertheless concludes that resource adequacy is not threatened in the PJM region. This is particularly significant, given that the PJM region is one of the largest and most heavily dependent on coal-fueled

[Page 329]
generation in the country. The PJM analysis notes, as EPA has acknowledged, that even where there is adequate generation capacity on a regional basis, localized reliability issues may emerge in connection with retirements that may need to be addressed.

In June 2011, the Bipartisan Policy Center issued a report analyzing potential collective impacts of EPA's pending power sector rules and concluding that "scenarios in which electric system reliability is broadly affected are unlikely to occur."[12]

The EPA has reviewed industry and NERC studies suggesting, contrary to the EPA's and these other groups' analyses, that EPA rules affecting the power sector (including this final rule, the CSAPR, EPA's proposed rule addressing power plant cooling water intake systems under section 316(b) of the Clean Water Act (CWA), and EPA's proposed rule addressing coal combustion residuals under the Resource Conservation and Recovery Act) will result in substantial power plant retirements. Some of these studies predict that such levels of retirements

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EPA Cross State Air Pollution Rule and Proposed National Emissions Standards for Hazardous Air Pollutants."

[12] Bipartisan Policy Center, June 2011, "Environmental Regulation and Electric System Reliability"

will have adverse effects on electric reliability in some regions of the country. Although the specifics of these analyses differ, in general they share a number of serious flaws in common that call their conclusions into question.

First, most of these studies make assumptions about the requirements ofthe EPA rules that are inconsistent with, and dramatically more expensive than, the EPA's actual proposals or final rules. For example, a large proportion of the retirements projected by several of these studies is attributable to their inaccurate assumption that EPA's cooling water intake rule under CWA section 316(b) would require all or virtually all existing power plants to install cooling towers. In one study, the reliability effects reported are based on inaccurate assumptions that all existing EGUs with a capacity utilization factor of less than 35 percent would close, and that all in-scope electric generators would be required to install cooling towers within 5 years, whereas the not-selected options with closed cycle cooling in EPA's proposal envisioned that permit authorities could exercise discretion to allow facilities 10 to 15 years' time to comply. In most cases, these analyses were performed before the CW A section 316(b) rule or the MATS rule were even proposed; even analyses subsequent to the CW A section 316(b) proposal continue to inaccurately portray EPA's proposed approach.

Second, in reporting the number of retirements, many analyses fail to differentiate between plant retirements attributable to the EPA rules and older, smaller, and less efficient plants that are already

scheduled for retirement because owners have made business decisions, based in significant pmi on market conditions, not to continue operating them. Third, most of these analyses fail to account for the broad range of responses available to address electric reliability concerns associated with power plant retirements, including upgrades to the transmission system, construction of new generation, and implementation of demand-side measures. These measures are discussed at greater length below.

As a preliminary matter, none of these situations, either alone or in combination, will necessarily lead to an electric reliability problem. There is excess generating capacity in the U.S. today and in most cases an EGU that closes, either temporarily until it comes into compliance or permanently, will not cause a reliability problem. As explained above, our modeling of the impact of this final rule at the regional level projects retirements of less than one percent of nationwide generating capacity and confirms that there will continue to be adequate capacity in all 32 subregions of the country as sources comply with

[Page 331]
the rule.[13] This analysis shows that significantly less capacity will close in response to the final rule than might have under the proposal. Moreover, the regional modeling of retirements demonstrates that plants that close in response to this rule are spread out across the country rather than clustered in one

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[13] *See* Technical Support Document on Resource Adequacy in this Docket.

area. Outside analyses have identified many of the same flaws in studies projecting large-scale retirements as a result of EPA's power sector rules. For example, On August 8, 2011, the Congressional Research Service (CRS).[14] issued a report that report that concluded that studies that assert that EPA rules will cause reliability problems, often make assumptions about the requirements of the rules that are inconsistent with, and dramatically more expensive than, the EPA's actual proposals. CRS further noted that EPA's rues will primarily affect units that are more than 40 years old, that have not yet installed state-of-the-art pollution controls, and that are inefficient. Many of these plants are being replaced by combined cycle natural gas plants, driven more my lower gas prices than by EPA's regulations. The June 2011 Bipartisan Policy Center report referenced above likewise highlighted many ofthese same shortcomings in the studies in question[15] as did M.J. Bradley and Analysis Group in a June 2011 report.[16]

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[14] James E. McCarthy and Claudia Copeland, Congressional Research Service, August 8, 2011, "EPA's Regulation of Coal-Fired Power: Is a 'Train Wreck' Coming?"

[15] Bipartisan Policy Center, June 2011, "Environmental Regulation and Electric System Reliability"

[16] M.J. Bradley & Associates and Analysis Group, June 2011, "Ensuring a Clean, Modern, Electric Generating Fleet while Maintaining Electric System Reliability."

[Page 477]

CHAPTER 6: IMPACTS AND COST ANALYSIS

6A – Impacts/Costs: Emission Impacts

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Comment 1: Commenter 17174 asks that the EPA take into consideration the effect of the proposed rule on non-HAP pollutants and the overall air quality and public health improvement to avoid exacerbating air quality issues.

Response to Comment 1: The EPA has determined that the proposed rule will lead to reductions of criteria and HAP responsible for significant adverse health effects and that such reductions will produce substantial public health benefits. Accounting for ancillary impacts is standard practice in benefit-cost assessment since these benefits are a consequence of the rule, regardless of the rule's intended purpose. This rule is expected to achieve substantial $PM_{2.5}$ health benefits resulting from primary PM and SO_2 emission reductions, and these co-benefits have been included in the regulatory impact assessment. Start here next

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[Page 478]

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Comment 5: Commenter 17768 states that the rule is justified based on the co-benefits that stem largely from PM reductions which represent the majority of total quantified and monetized benefits. The commenter argues that is important to account for

such co-benefits or ancillary benefits because they are just as significant as countervailing risks and they help to justify the cost-benefit analysis for the regulation.

Response to Comment 5: The EPA agrees that it is valuable to quantify the $PM_{2.5}$ health co-benefits of this rule. Accounting for ancillary benefits is standard practice in benefit-cost assessment since these benefits are a consequence of the rule, regardless of the rule's intended purpose. The EPA estimates all of the anticipated costs and benefits associated with a regulatory action, to the extent feasible, for the purpose of determining the likely impacts, not to justify an action. This rule is expected to achieve substantial $PM_{2.5}$ health benefits resulting from primary PM and SO_2 emission reductions, and these cobenefits are thus an important category to quantify.

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6B – Impacts/Costs: Emission Reductions

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Comment 10: Commenter 17884 agrees with the National Mining Association comments and points out that even the EPA's own RIA shows that most of the benefit of the proposed rule will come from reducing SO_2 emissions, and ambient $PM_{2.5}$, rather than HAP. The commenter also believes that the

EPA exaggerates the $PM_{2.5}$ emissions, which are already addressed under other CAA programs.

Response to Comment 10: The EPA disagrees with this commenter that $PM_{2.5}$ health co-benefits should be excluded in the estimation of benefits expected by MATS. Accounting for ancillary benefits is standard practice in benefit-cost assessment since these benefits are a consequence of the rule, regardless of the rule's intended purpose (as noted also by Commenter 17768). As such, the EPA estimates all of the anticipated costs and benefits associated with a regulatory action, to the extent feasible, for the purpose of determining the likely impacts, not to justify an action. This rule is expected to achieve 483 substantial $PM_{2.5}$ health benefits resulting from primary PM and SO_2 emission reductions, and these cobenefits are thus an important category to quantify.

Consideration of ancillary benefits in benefit-cost analysis is directed by OMB Circular A-4 (p. 26, available at: http://www.whitehouse.gov /omb/circulars_a004_a-4/):

> "Your analysis should look beyond the direct benefits and direct costs of your rulemaking and consider any important ancillary benefits and countervailing risks. An ancillary benefit is a favorable impact of the rule that is typically unrelated or secondary to the statutory purpose of the rulemaking (e.g., reduced refinery emissions due to more stringent fuel economy standards for light trucks) while a countervailing risk is an adverse economic, health, safety, or

> environmental consequence that occurs due to a rule and is not already accounted for in the direct cost of the rule (e.g., adverse safety impacts from more stringent fuel-economy standards for light trucks)."

It is also directed by the EPA's Guidelines for Preparation of Economic Analyses (p. 11-2, available at: http://yosemite.epa.gov/ee/epa/eed.nsf/pages/Guidelines.html):

> "An economic analysis of regulatory or policy options should present all identifiable costs and benefits that are incremental to the regulation or policy under consideration. These should include directly intended effects and associated costs, as well as ancillary (or co-) benefits and costs."

In line with this guidance, the EPA estimates all of the anticipated costs and benefits associated with a regulatory action, to the extent feasible. We further note that we were unable to monetize other important benefits, including health benefits of ozone reductions, additional $PM_{2.5}$ health benefits, and direct health benefits of reducing SO_2. If we were able to fully monetize these benefits, the benefits would exceed the costs by an even greater amount than we currently estimate.

The EPA disagrees that the quantified $PM_{2.5}$ health benefits are double-counted with the health benefits achieved by other regulations. The EPA's standard practice for its rules is to estimate, to the extent data and time allow, all benefits of the emissions reductions achieved by a rule *beyond control*

requirements for other rules. If this rule was duplicative with other rules, then there would be no additional costs or benefits attributable to this rule.

When the EPA estimates the benefits for rules like MATS, the EPA includes other rules such as the CSAPR in the "baseline." Any emission changes expected as a result of MATS are additional emission reductions beyond those regulations (e.g., CSAPR) that were considered to be part of the baseline. Therefore, the benefits from particle reductions are not double counting – they are real additional health benefits from emissions reductions achieved by MATS alone.

Further, the $PM_{2.5}$ health benefits expected from this rule are not double-counted with benefits estimated in the NAAQS RIAs. The NAAQS RIAs illustrate the potential costs and benefits of attaining a new air quality standard nationwide based on an array of emission control strategies for different sources. In short, NAAQS RIAs hypothesize, but do not predict, the control strategies that states may choose to enact when implementing a NAAQS. The setting of a NAAQS does not directly result in costs or benefits, and as such, the NAAQS RIAs are merely illustrative and are not intended to be added to the costs and benefits of other regulations that result in specific costs of control and emission reductions.

[Page 484]
However, some costs and benefits estimated in this RIA account for the same air quality improvements as estimated in the illustrative $PM_{2.5}$ NAAQS RIA.

In implementing these rules, emission controls may lead to reductions in ambient $PM_{2.5}$ below the PM NAAQS in some areas. It is important to emphasize that NAAQS are not set at a level of zero risk. Instead, the NAAQS reflect the level determined by the Administrator to be protective of public health within an adequate margin of safety, taking into consideration effects on susceptible populations based on the scientific literature available at the time the standard is set. Although benefits occurring below the standard may be less certain than those occurring above the standard, the EPA considers them to be legitimate components of the total benefits estimate.

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6K - Impacts/Costs: Health Co-Benefits

[Page 627]

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4. Criteria co-benefits should not be considered in analysis.

Comment 6: Many commenters (17702, 17716, 17751, 17753, 17754, 17765, 17775, 17799, 17813, 17855, 17912, 17919, 18034, 18428, 18488, 18498, 18963, 19114, 18023) question the use of criteria co-benefits to justify HAP regulation. They suggest that the inclusion of co-benefits is contrary to the original intention of reducing Hg emissions, because the reductions of $PM_{2.5}$ emissions can be expected to be achieved through other regulations. Commenter 17765 states that the little incremental health benefits from the proposed rule do not justify its

economic impacts. Commenter 17716 estimates that without co-benefits, the "net benefits" of the proposed rule would be negative $42,000,000,000 to negative $130,000,000,000. Commenters 17716 and 17799 question the intent of the CAA or legislative history to have co-benefits from criteria pollutants regulated under a different CAA regulatory scheme serve as the driving force to curb HAP emissions through MACT regulation. Commenters 17754 and 18034 acknowledge that benefits beyond those from Hg emissions reductions will be up to $130 billion annually, but again, since these benefits come from co-benefits from reducing $PM_{2.5}$ emissions, consider the cost-benefit analysis supporting regulation of Hg emission to be flawed. Commenter 17775 attached a memo by Dr. Anne Smith providing technical comments on the RIA for the proposed rule and discussing the use of co-benefits. The commenter states that $PM_{2.5}$ benefits are attributable to the control of HAP acid gases, yet public exposures to HAP acid gas emissions were found to be far below the reference concentration levels for those HAP, which the EPA defines as being without an appreciable

[Page 628]
risk. Commenters 17912 and 17919 question the EPA's legal justification for the proposed rule that argues non-Hg HAP must be regulated. Commenter 17719 points out that there is a separate program for the regulation of $PM_{2.5}$, and the EPA does not address whether there is a less expensive way to achieve the same benefits attributed to the proposed rule, such as those included in the $PM_{2.5}$ program. Commenter 17719 believes this is pertinent, since

the EPA is mandated to find the most cost effective solution for regulatory priority.

Multiple commenters (18023, 16469, 17621, 17718, 17751, 17761, 17800, 17816, 17919, 17855, 18033, 18963) find the EPA calculation of $PM_{2.5}$ NAAQS benefits to be incorrect because the commenters say the EPA is either double counting potential benefits of the NAAQS program in the calculation of benefits from the proposed rule, or relying on the supposition of health benefits from any PM reduction anywhere. Commenter 18023 considers this an unfounded supposition that both the EPA and the EPA science advisors have rejected as too uncertain to adopt when setting $PM_{2.5}$ NAAQS. Commenter 18023 points out that if these $PM_{2.5}$ benefits are disregarded, the monetized benefits for the proposed rule drop to $0.576 billion, from CO_2 reductions and HAP reductions. The commenter states that this change means the cost of the proposed rule would exceed the monetized HAP benefits by a factor of at least 1,800.

Comment 7: Numerous commenters (16469, 16849, 17638, 17681, 17702, 17730, 17799, 17848, 17919, 18018, 18033, 18500, 18023) estimate that 90-99% of the benefits the EPA attributes to the proposed rule actually come from $PM_{2.5}$ reductions from reduced emissions of SO_2, which is not a HAP, and did not indicate benefits from acid gas reductions. Commenters believe the same benefits would be delivered by other CAA rulemakings including PM, SO_2 and ozone NAAQS and the Cross-State Air Pollution rule. Commenter 16849 points out the limitations of the proposed solutions due to the fact

that multiple emission control equipment do not always work together harmoniously following a retrofit. Commenter 17702 believes that proposing air toxic limits more restrictive than those envisioned under CAMR would result in greater costs without commensurate benefits to the public. Commenter 17730 believes the proposed rule should be based on the rule's ability to reduce the emissions of HAP that provide a public health benefit after imposition of the CAA requirements and the associated public health and environmental benefits from those reductions. Commenter 17848 points out that the estimated health benefits from the proposed rule were compared with the estimated health benefits from the Transport Rule SO_2 reductions and the number of avoided outcomes per 1,000 tons of SO_2 reduction is nearly identical for 2014 and 2016. However, the commenter points out that ambient $PM_{2.5}$ levels should decrease between those 2 years as a result of the Transport Rule reductions. Therefore the commenter says that since baseline emissions should be lower after Transport Rule implementation, a smaller quantity of SO_2 reductions would be achieved by the proposed rule. Several commenters (18023, 17638, 17681) state that over 80% of the estimated $PM_{2.5}$ health benefits are assumed to occur in areas that meet the levels the EPA is currently considering for a new $PM_{2.5}$ NAAQS, and thus should not be considered under this rule. Commenter 18500 cautions that the EPA's monetizing benefits estimate due to CO_2 reductions should be considered carefully because a of the questions associated with climate change.

Comment 8: Many commenters (16469, 17621, 17623, 17637, 17681, 17702, 17751, 17761, 17775, 17800, 17855, 17884, 17919, 18033, 18963, 18023) note that the $PM_{2.5}$ co-benefits to which many of the proposed rule's benefits are attributed are mainly based on emission reductions in areas already achieving the annual $PM_{2.5}$ NAAQS or are being addressed by other rules. As such, commenters 17623 and 17855 ask that the EPA explain what additional PM benefits are derived from the proposed rule. Commenter 17681 considers the costs of the proposed rule to be very low and not outweighed by the "contrived" benefits. Commenters 17919 and 18023 state that the NAAQS set a level of $PM_{2.5}$ that the

[Page 629]
EPA found to be sufficient to public health and welfare with an adequate margin of safety and areas in attainment with this level are already safe from health risks. Some commenters (17855, 17621, 17637, 17718, 17761, 18963) state that attainment of the NAAQS for $PM_{2.5}$ is already being addressed on both the local and regional basis through SIPs and CSAPR. Commenter 18033 points out that the EPA "is preparing to propose a new [lower] $PM_{2.5}$ NAAQS...[but] until it does so...it is inappropriate for EPA to adopt rules based on claimed benefits below the current NAAQS level." Commenter 17621 requests that the EPA clearly articulate the individual benefits to all of its pending air rules to clarify the issue of double counting benefits.

Comment 9: Commenter 17876 states that the EPA's attribution of 90% of the health benefits under

this rulemaking to justify the further regulation of PM is problematic based on recent studies. *See, e.g.*, Koop, Gary, Ross McKitrick and Lise Tole (201 0) "Air Pollution, Economic Activity and Respiratory Illness: Evidence from Canadian Cities 1974-1994" *Environmental Modeling and Software* 2010, doi: 10.1 016/j.envsoft.201 0.01.01 0; Gary Koop, Lise Tole, "Measuring the Health Effects of Air Pollution: to what extent can we really say that people are dying from bad air?" Journal of Environmental Economics and Management (2004), 30-54.

Comment 10: Commenter 18023 believes the EPA's flawed cost-benefit analyses makes it difficult to assess the proposed rule under UMRA and EO 12866, which require the EPA to assess both the costs and benefits of the proposed rule. The commenter believes the EPA is double counting benefits associated with $PM_{2.5}$ in its RIA, and therefore has failed to meet its obligations to promulgate a regulation that imposes the least burden on society.

Response to Comments 6 - 10: On inclusion of $PM_{2.5}$ health co-benefits, the EPA disagrees with commenters that $PM_{2.5}$ health co-benefits should be excluded in the estimation of benefits expected by MATS. Accounting for ancillary benefits is standard practice in benefit-cost assessment since these benefits are a consequence of the rule, regardless of the rule's intended purpose (as noted also by commenter 17768). As such, the EPA estimates all of the anticipated costs and benefits associated with a regulatory action, to the extent feasible, for the purpose of determining the likely impacts, not to

justify an action. This rule is expected to achieve substantial $PM_{2.5}$ health benefits resulting from primary PM and SO_2 emission reductions, and these co-benefits are thus an important category to quantify.

Consideration of ancillary benefits in benefit-cost analysis is directed by OMB Circular A-4 (p. 26, available at: http://www.whitehouse.gov/omb/circulars_a004_a-4/):

"Your analysis should look beyond the direct benefits and direct costs of your rulemaking and consider any important ancillary benefits and countervailing risks. An ancillary benefit is a favorable impact of the rule that is typically unrelated or secondary to the statutory purpose of the rulemaking (e.g., reduced refinery emissions due to more stringent fuel economy standards for light trucks) while a countervailing risk is an adverse economic, health, safety, or environmental consequence that occurs due to a rule and is not already accounted for in the direct cost of the rule (e.g., adverse safety impacts from more stringent fuel-economy standards for light trucks)."

It is also directed by the EPA's Guidelines for Preparation of Economic Analyses (p. 11-2, available at: http://yosemite.epa.gov/ee/epa/eed.nsf/pages/Guidelines.html):

"An economic analysis of regulatory or policy options should present all identifiable costs and benefits that are incremental to the regulation or policy under consideration. These should include directly intended

effects and associated costs, as well as ancillary (or co-) benefits and costs."

[Page 630]
In line with this guidance, the EPA estimates all of the anticipated costs and benefits associated with a regulatory action, to the extent feasible. We further note that we were unable to monetize other important benefits, including health benefits of ozone reductions, additional $PM_{2.5}$ health benefits, and direct health benefits of reducing SO_2. If we were able to fully monetize these benefits, the benefits would exceed the costs by an even greater amount than we currently estimate.

Regarding commenters' assertion that the EPA is double-counting $PM_{2.5}$ health benefits achieved by MATS with those achieved by other regulations and NAAQS, the EPA disagrees with these commenters that the quantified $PM_{2.5}$ health benefits are double-counted with the health benefits achieved by other regulations. The EPA's standard practice for its rules is to estimate, to the extent data and time allow, all benefits of the emissions reductions achieved by a rule *beyond control requirements for other rules.* If this rule was duplicative with other rules, then there would be no additional costs or benefits attributable to this rule.

When the EPA estimates the benefits for rules like MATS, we include other rules such as the CSAPR in the "baseline." Any emission changes expected as a result of MATS are additional emission reductions beyond those regulations (e.g., CSAPR) that were considered to be part of the baseline. Therefore, the benefits from particle reductions are not double-

counting – they are real health benefits from emissions reductions achieved by MATS alone.

Further, the $PM_{2.5}$ health benefits expected from this rule are not double-counted with benefits estimated in the NAAQS RIAs. The NAAQS RIAs illustrate the potential costs and benefits of attaining a new air quality standard nationwide based on an array of emission control strategies for different sources. In short, NAAQS RIAs hypothesize, but do not predict, the control strategies that states may choose to enact when implementing a NAAQS. The setting of a NAAQS does not directly result in costs or benefits, and as such, the NAAQS RIAs are merely illustrative and are not intended to be added to the costs and benefits of other regulations that result in specific costs of control and emission reductions. However, some costs and benefits estimated in this RIA account for the same air quality improvements as estimated in the illustrative $PM_{2.5}$ NAAQS RIA.

Regarding quantification of health benefits below the $PM_{2.5}$ NAAQS, the EPA notes that in implementing these rules, emission controls may lead to reductions in ambient $PM_{2.5}$ below the PM NAAQS in some areas. It is important to emphasize that NAAQS are not set at a level of zero risk. Instead, the NAAQS reflect the level determined by the Administrator to be protective of public health within an adequate margin of safety, taking into consideration effects on susceptible populations based on the scientific literature available at the time the standard is set. Although benefits occurring below the standard may be less certain than those occurring above the

standard, the EPA considers them to be legitimate components of the total benefits estimate.

In response to the comment on climate benefits, we use best available scientific information and methods in monetizing the climate benefits of this rule and include a careful discussion of the associated uncertainties and limitations.

5. Health impacts are minimal and are not thoroughly investigated.

Comment 11: Some commenters (17621, 17689, 17775, 18033, 18963, 18023) argue that utility acid gas emissions (primarily HCl) cause insignificant harm. Commenter 18023 states that the conclusion that HCl could exacerbate ecosystem acidification is speculative and unsubstantiated. Commenters 18033 and 18963 point out that the EPA never provided a finding of public health concern to regulate

[Page 631]
non-Hg HAP, and provides no evidence that "more stringent control of acid gases would benefit ecosystems other than some vague referencing of the possibility." Commenters 17775 and 18033 argue that the predominant HAP in the acid gas group, HCl, poses no significant potential for exceeding the chronic RfC value according to the EPA's own calculations, even though the $PM_{2.5}$ benefits in the RIA are solely attributable to the control of HAP acid gases. Commenters 17621 and 18033 argue further that because HCl is a very minor contributor to all acidification of water bodies, the EPA's need for regulating acid gases from EGU's is insignificant. Commenter 17621 points out that because of this,

HCl emissions have "not been the focus of past U.S. assessments of acidification."

Response to Comment 11: Based on recent peer-reviewed research including Evans et al. (2011), acid gases can significantly contribute to acidification. The paper presents experimental results that show 1) that HCl is highly mobile in the environment, transferring acidity easily through soils and water, 2) that HCl can transport longer distances than previously thought (given its presence in remote ecosystems, and 3) that it can be a larger driver of acidification previously thought. In 2009 the EPA published a comprehensive risk assessment of acidification effects of nitrogen and sulfur deposition and in 2011 published a Policy Assessment based on the findings in the Risk Assessment (both documents are available at: http://www.epa.gov/ttn/naaqs/standards/no2so2sec/index.html). Given the extent and importance of the sensitive ecosystems evaluated in the review of nitrogen and sulfur deposition any substance that contributes to further acidification must be considered to be affecting the public welfare.

Comment 12: Several commenters (16469, 17621, 17715) take issue with the use of the two primary health studies used in the benefits analysis (Pope et al., 2002; Laden et al., 2006). Commenter 17715 argues that the studies take a simplistic approach to their calculations (grouping all PM components together) even though there is evidence that PM components do not all have equal health significance. Commenter 17621 argues that because the dose-response function for $PM_{2.5}$ relied on two studies and

not a full review of the published literature, it is flawed and only reflects a subset of the literature. Commenter 17621 also takes issue with the EPA's choice of dose-response function from the Laden study; the commenter argues that the EPA should have used only the most recent mortality risks instead of the risk for a combined time period, because the more recent time period is more relevant to the present. Commenter 17621 points out that had the EPA used the most recent mortality risk, the benefit estimates would be much lower. Commenter 17621 disagrees with the EPA's statement that some studies were excluded from analysis due to having study populations of a "selective nature," because the commenter argues that this is true of all studies, including the Pope and Laden studies. Commenter 17621 argues that the inclusion of other studies would be appropriate and could change the estimated benefits. Commenter 17621 argues further that the methodology used in these studies appears flawed, particularly in the methods used to estimate mortality benefits. They state that this could overestimate the benefits associated with changes in PM concentrations, and thus these studies should not be used until the flaws are remedied.

Response to Comment 12: The EPA disagrees that the methodology used to estimate $PM_{2.5}$ health impacts is flawed. The EPA methods for quantifying health benefits of emission reductions are based on the best available peer-reviewed science and methods that have withstood scrutiny from the EPA's independent SAB, the National Academy of Sciences, and continuous interagency review. We note that the evidence on differential toxicity of

$PM_{2.5}$ components and mixtures is currently inconclusive. We therefore follow the advice of the EPA's Clean Air Science Advisory Committee (Hammitt et al. 2010, available at: http://yosemite.epa.gov/sab/sabproduct.nsf/fedrgstr_activites/2nd%20Prospective%20812%20Study!OpenDocument&TableRow=2.3#2.), which concluded that "Although the possibility of differential toxicity among $PM_{2.5}$ components could be an important issue, the Council concludes that the state of the

[Page 632]
knowledge does not permit a useful sensitivity analysis at this time" (p. 6). In response to commenter 17621, we note that we use concentration-response factors from the broadest time periods available to take advantage of the available data most comprehensively. The choice of relative risk estimates from Pope et al. (2002) and Laden et al. (2006) is supported by the EPA Advisory Council on Clean Air Compliance Analysis (Hammitt et al. 2010, available at: http://yosemite.epa.gov/sab/sabproduct.nsf/9288428b8eeea4c885257242006935a3/59e06b6c5ca66597852575e7006c5d09!OpenDocument&TableRow=2.3#2.):

"Overall, the HES finds the EPA analyses, data choices, and methodologies to be sound. The EPA bases its estimates of the mortality benefits of reducing fine particulate matter (PM2.5) on data analyzed from two large, long-running landmark studies on the health effects of air pollution, the Harvard Six Cities Study and the American Cancer Society (ACS) Cancer Prevention Study (CPS). The HES finds the selection of these cohort studies as the

underlying basis for PM mortality benefit estimates to be a good choice" (p. 1).

We further note that we also estimate mortality using functions derived by 12 experts in an EPAsponsored expert elicitation (Roman et al. 2008). The Pope et al. (2002) and Laden et al. (2006) studies were found to be near the 25th and 75th %iles of the mortality effect estimates garnered from the expert elicitation. Our use of the expert elicitation functions provides one estimate of the range of possible impacts.

{Regulatory Impact Analysis for the Final Mercury and Air Toxics Standards
EPA-HQ-OAR-2009-0234-20131
December 2011}
[Page ES-1]

EXECUTIVE SUMMARY

This Regulatory Impact Analysis (RIA) presents the health and welfare benefits, costs, and other impacts of the final Mercury and Air Toxics Standards (MATS) in 2016.

ES.1 Key Findings

This rule will reduce emissions of Hazardous Air Pollutants (HAP), including mercury, from the electric power industry. As a co-benefit, the emissions of certain $PM_{2.5}$ precursors such as SO_2 will also decline. EPA estimates that this final rule will yield annual monetized benefits (in 2007$) of between $37 to $90 billion using a 3% discount rate and $33 to $81 billion using a 7% discount rate. The great majority of the estimates are attributable to co-benefits from 4,200 to 11,000 fewer $PM_{2.5}$-related premature mortalities. The monetized benefits from reductions in mercury emissions, calculated only for children exposed to recreationally caught freshwater fish, are expected to be $0.004 to $0.006 billion in 2016 using a 3% discount rate and $0.0005 to $0.001 billion using a 7% discount rate. The annual social costs, approximated by the compliance costs, are $9.6 billion (2007$) and the annual monetized net benefits are $27 to $80 billion using 3% discount rate

or $24 to $71 billion using a 7% discount rate.[1] The benefits outweigh costs by between 3 to 1 or 9 to 1 depending on the benefit estimate and discount rate used. There are some costs and important benefits that EPA could not monetize, such as other mercury reduction benefits and those for the HAP other than mercury being reduced by this final rule. Upon considering these limitations and uncertainties, it remains clear that the benefits of the MATS are substantial and far outweigh the costs. Employment impacts associated with the final rule are estimated to be small.

The benefits and costs in 2016 of the final rule are in Table ES-1. The emission reductions from the electricity sector that are expected to result from the rule are reported in Table ES-2.

Table ES-1. Summary of EPA's Estimates of Annualized[a] Benefits, Costs, and Net Benefits of the Final MATS in 2016[b] (billions of 2007$)

Description	Estimate (3% Discount Rate)	Estimate (7% Discount Rate)
Costs[c]	$9.6	$9.6
Benefits[d,e,f]	$37 to $90 + B	$33 to $81 + B
Net benefits (benefits-costs)[g]	$27 to $80 + B	$24 to $71 + B

[a] All estimates presented in this report represent annualized estimates of the benefits and costs of the final MATS in 2016 rather than the net present value of a stream of benefits and costs in these particular years of analysis.

[b] Estimates rounded to two significant figures and represent annualized benefits and costs anticipated for the year 2016.

[c] Total social costs are approximated by the compliance costs. Compliance costs consist of IPM projections, monitoring/reporting/recordkeeping costs, and oil-fired fleet analysis costs. For a complete discussion of these costs refer to Chapter 3. Costs were annualized using a 6.15% discount rate.

[d] Total benefits are composed primarily of monetized PM-related health benefits. The reduction in premature fatalities each year accounts for over 90% of total monetized benefits. Benefits in this table are nationwide and are associated with directly emitted $PM_{2.5}$ and SO_2 reductions. The estimate of social benefits also includes CO_2-related benefits calculated using the social cost of carbon, discussed further in Chapter 5.

[e] Not all possible benefits or disbenefits are quantified and monetized in this analysis. B is the sum of all unquantified benefits and disbenefits. Data limitations prevented us from quantifying these endpoints, and as such, these benefits are inherently more uncertain than those benefits that we were able to quantify. Estimates here are subject to uncertainties discussed further in the body of the document. Potential benefit categories that have not been quantified and monetized are listed in Table ES-5.

[f] Mortality risk valuation assumes discounting over the SAB-recommended 20-year segmented lag structure. Results reflect the use of 3% and 7% discount rates consistent with EPA and OMB guidelines for preparing economic analyses (EPA, 2000; OMB, 2003).

[g] Net benefits are rounded to two significant figures. Columnar totals may not sum due to rounding.

[Page ES-2 cont.]

Table ES-2: Projected Electricity Generating Unit (EGU) Emissions of SO_2, NO_X, Mercury, Hydrogen Chloride, PM, and CO_2 with the Base Case and with MATS, 2015 [a,b]

	Million Tons			Thousand Tons		CO_2
	SO_2	NO_X	Mercury (Tons)	HCl	$PM_{2.5}$	(Million Metric Tonnes)
Base All EGUs	3.4	1.9	28.7	48.7	277	2,230
Covered EGUs	3.3	1.7	26.6	45.3	270	1,906
MATS All EGUs	2.1	1.9	8.8	9.0	227	2,215
Covered EGUs	1.9	1.7	6.6	5.5	218	1,883

[a] Source: Integrated Planning Model run by EPA, 2011

[b] The year 2016 is the compliance year for MATS, though as we explain in later chapters, we use 2015 as a proxy for compliance in 2016 for IPM emissions and costs due to availability of modeling impacts in that year.

[Page ES-3]
ES.1.1 Health Co-Benefits

The final MATS Rule is expected to yield significant health co-benefits by reducing emissions not only of HAP such as mercury, but also significant co-benefits by reducing to direct fine particles ($PM_{2.5}$) and sulfur dioxide, which contributes to the formation of $PM_{2.5}$.

Our analyses suggest this rule would yield co-benefits in 2016 of $37 to $90 billion (based on a 3% discount rate) and $33 to $81 billion (based on a 7% discount rate). This estimate reflects the economic value of a range of avoided health outcomes including 510 fewer mercury-related IQ points lost as well as avoided $PM_{2.5}$-related impacts, including 4,200 to 11,000 premature deaths, 4,700 nonfatal heart attacks, 2,600 hospitalizations for respiratory and cardiovascular diseases, 540,000 lost work days, and 3.2 million days when adults restrict normal activities because of respiratory symptoms exacerbated by $PM_{2.5}$. We also estimate substantial additional health improvements for children from reductions in upper and lower respiratory illnesses, acute bronchitis, and asthma attacks. See Table ES-3 for a list of the annual reduction in health effects expected in 2016 and Table ES -4 for the estimated value of those reductions. In addition, we include in our monetized co-benefits estimates the effect from the reduction in CO_2 emissions resulting from this rule. We calculate the co-benefits associated with

these emission reductions using the interagency estimates of the social cost of carbon (SCC)[1]

It is important to note that the health co-benefits from reduced $PM_{2.5}$ exposure reported here contain uncertainty, including from the following key assumptions:

1. The $PM_{2.5}$-related co-benefits of the regulatory alternatives were derived through a benefit per-ton approach, which does not fully reflect local variability in population density, meteorology, exposure, baseline health incidence rates, or other local factors that might lead to an over-estimate or under-estimate of the actual co-benefits of controlling PM precursors. In addition, differences in the distribution of emissions reductions across states between the modeled scenario and the final rule scenario add uncertainty to the final benefits estimates.

[Page ES-4]

2. We assume that all fine particles, regardless of their chemical composition, are equally potent in

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[1] Docket ID EPA-HQ-OAR-2009-0472-114577, Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, Interagency Working Group on Social Cost of Carbon, with participation by Council of Economic Advisers, Council on Environmental Quality, Department of Agriculture, Department of Commerce, Department of Energy, Department of Transportation, Environmental Protection Agency, National Economic Council, Office of Energy and Climate Change, Office of Management and Budget, Office of Science and Technology Policy, and Department of Treasury (February 2010). Also available at http://www.epa.gov/otaq/climate/regulations.htm

causing premature mortality. This is an important assumption, because $PM_{2.5}$ produced via transported precursors emitted from EGUs may differ significantly from direct $PM_{2.5}$ released from diesel engines and other industrial sources, but the scientific evidence is not yet sufficient to allow differential effects estimates by particle type.

3. We assume that the health impact function for fine particles is linear within the range of ambient concentrations under consideration. Thus, the estimates include health co-benefits from reducing fine particles in areas with varied concentrations of $PM_{2.5}$, including both regions that are in attainment with fine particle standard and those that do not meet the standard down to the lowest modeled concentrations.

A large fraction of the $PM_{2.5}$-related benefits associated with this rule occur below the level of the National Ambient Air Quality Standard (NAAQS) for annual $PM_{2.5}$ at 15 $\mu g/m^3$, which was set in 2006. It is important to emphasize that NAAQS are not set at a level of zero risk. Instead, the NAAQS reflect the level determined by the Administrator to be protective of public health within an adequate margin of safety, taking into consideration effects on susceptible populations. While benefits occurring below the standard may be less certain than those occurring above the standard, EPA considers them to be legitimate components of the total benefits estimate.

Based on the modeled interim baseline which is approximately equivalent to the final baseline (see Appendix 5A), 11% and 73% of the estimated avoided

premature deaths occur at or above an annual mean $PM_{2.5}$ level of 10 µg/m3 (the LML of the Laden et al. 2006 study) and 7.5 µg/m3 (the LML of the Pope et al. 2002 study), respectively. These are the source studies for the concentration-response functions used to estimate mortality benefits. As we model avoided premature deaths among populations exposed to levels of $PM_{2.5}$, we have lower confidence in levels below the LML for each study. However, studies using data from more recent years, during which time PM concentrations have fallen, continue to report strong associations with mortality. EPA briefly describes these uncertainties below and in more detail in the benefits chapter of this RIA.

ES.1.2 Welfare Co-Benefits

The term *welfare co-benefits* covers both environmental and societal benefits of reducing pollution, such as reductions in damage to ecosystems, improved visibility and improvements in recreational and commercial fishing, agricultural yields, and forest

[Page ES-5]
productivity. EPA did not quantify any of the important welfare co-benefits expected from the final MATS, but these are discussed in detail in Chapter 5.

Table ES-3. Estimated Reduction in Incidence of Adverse Health Effects of the Mercury and Air Toxics Standards (95% confidence intervals)[a,b]

Impact	Eastern U.S.[c]	Western U.S.	Total
Mercury-Related Endpoints			
IQ Points Lost			510.8
PM-Related Endpoints			
Premature death			
Pope et al. (2002) (age >30)	4,100 (1,100 – 7,000)	130 (30 – 220)	4,200 (1,200 – 7,200)
Laden et al. (2006) (age >25)	10,000 (4,800 – 16,000)	320 (140 – 510)	11,000 (5,000 – 17,000)
Infant (< 1 year)	19 (-21 – 59)	1 (-1 – 2)	20 (-22 – 61)
Chronic bronchitis	2,700 (89 – 5,400)	100 (-1 – 210)	2,800 (88 – 5,600)
Non-fatal heart attacks (age > 18)	4,600 (1,200 – 8,100)	120 (25 – 210)	4,700 (1,200 – 8,300)
Hospital admissions—respiratory (all ages)	820 (320 – 1,300)	17 (6 – 27)	830 (330 – 1,300)
Hospital admissions—cardiovascular (age > 18)	1,800 (1,200 – 2,100)	42 (27 – 50)	1,800 (1,200 – 2,200)
Emergency room visits for asthma (age < 18)	3,000 (1,500 – 4,500)	110 (52 – 160)	3,100 (1,600 – 4,700)
Acute bronchitis (age 8-12)	6,000 (-1,400 – 13,000)	250 (-69 – 560)	6,300 (-1,400 – 14,000)
Lower respiratory symptoms (age 7-14)	77,000 (30,000 – 120,000)	3,100 (1,100 – 5,200)	80,000 (31,000 – 130,000)
Upper respiratory symptoms (asthmatics age 9-18)	58,000 (11,000 – 110,000)	2,400 (360 – 4,400)	60,000 (11,000 – 110,000)
Asthma exacerbation (asthmatics age 6-18)	130,000 (4,500 – 430,000)	5,200 (-6 – 18,000)	130,000 (4,500 – 450,000)
Lost work days (ages 18-65)	520,000 (440,000 – 600,000)	21,000 (18,000 – 24,000)	540,000 (460,000 – 620,000)
Minor restricted-activity days (ages 18-65)	3,100,000 (2,500,000 – 3,700,000)	120,000 (99,000 – 150,000)	3,200,000 (2,600,000 – 3,800,000)

[a] Estimates rounded to two significant figures; column values will not sum to total value.

[b] The negative estimates for certain endpoints are the result of the weak statistical power of the study used to calculate these health impacts and do not suggest that increases in air pollution exposure result in decreased health impacts.

[c] Includes Texas and those states to the north and east.

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[Page ES-9]

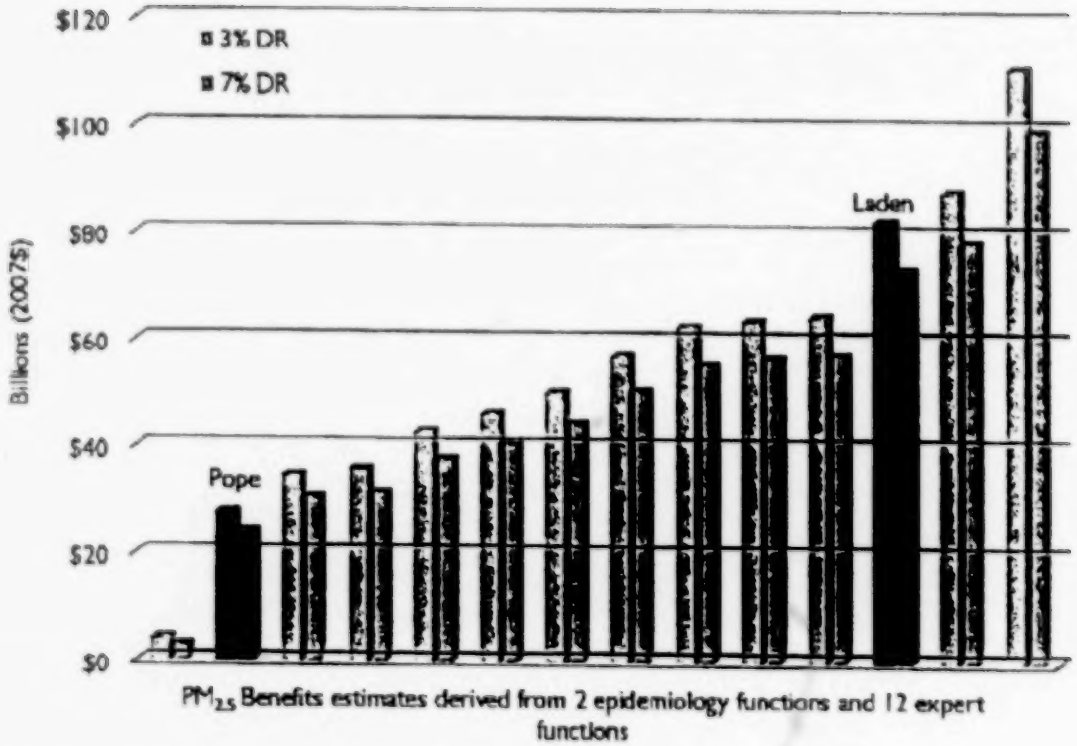

Figure ES-2. Net Benefits of the MATS Rule According to PM2.5 Epidemiology or Expert-Derived Mortality Risk Estimate[a,b]

[a] Based on the modeled interim baseline, which is approximately equivalent to the final baseline (see Appendix 5A)

[b] Column total equals sum of $PM_{2.5}$-related mortality and morbidity benefits.

ES.2 Not All Benefits Quantified

EPA was unable to quantify or monetize all of the health and environmental benefits associated with the final MATS Rule. EPA believes these unquantified benefits could be substantial, including the overall value associated with HAP reductions, value of increased agricultural crop and commercial forest yields, visibility improvements, and reductions in nitrogen and acid deposition and the resulting changes in ecosystem functions. Tables ES-5 and ES-6 provide a list of these benefits

[ES-10]

Table ES-5. Human Health Effects of Pollutants Affected by the Mercury and Air Toxics Standards

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information[a]
Improved Human Health				
Reduced incidence of premature mortality from exposure to $PM_{2.5}$	Adult premature mortality based on cohort study estimates and expert elicitation estimates (age >25 or age >30)	✓	✓	Section 5.4
	Infant mortality (age <1)	✓	✓	Section 5.4
Reduced incidence of morbidity from exposure to $PM_{2.5}$	Non-fatal heart attacks (age > 18)	✓	✓	Section 5.4
	Hospital admissions—respiratory (all ages)	✓	✓	Section 5.4
	Hospital admissions—cardiovascular (age >18)	✓	✓	Section 5.4
	Emergency room visits for asthma (age <18)	✓	✓	Section 5.4
	Acute bronchitis (age 8–12)	✓	✓	Section 5.4
	Lower respiratory symptoms (age 7–14)	✓	✓	Section 5.4
	Upper respiratory symptoms (asthmatics age 9-11)	✓	✓	Section 5.4
	Asthma exacerbation (asthmatics age 6–18)	✓	✓	Section 5.4
	Lost work days (age 18-65)	✓	✓	Section 5.4
	Minor restricted-activity days (age 18–65)	✓	✓	Section 5.4
	Chronic bronchitis (age >26)	✓	✓	Section 5.4
	Other cardiovascular effects (e.g., other ages)	—	—	PM ISA[c]

[Page ES-10]

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information[a]
Improved Human Health				
	Other respiratory effects (e.g., pulmonary function, non-asthma ER visits, non-bronchitis chronic diseases, other ages and populations)	—	—	PM ISA[c]
	Reproductive and developmental effects (e.g., low birth weight, pre-term births, etc)	—	—	PM ISA[c, d]
	Cancer, mutagenicity, and genotoxicity effects	—	—	PM ISA[c, d]
Reduced incidence of mortality from exposure to ozone	Premature mortality based on short-term study estimates (all ages)	—	—	Ozone CD, Draft Ozone ISA[b]
	Premature mortality based on long-term study estimates (age 30–99)	—	—	Ozone CD, Draft Ozone ISA[b]
Reduced incidence of morbidity from exposure to ozone	Hospital admissions—respiratory causes (age > 65)	—	—	Ozone CD, Draft Ozone ISA[b]
	Hospital admissions—respiratory causes (age <2)	—	—	Ozone CD, Draft Ozone ISA[b]
	Emergency room visits for asthma (all ages)	—	—	Ozone CD, Draft Ozone ISA[b]
	Minor restricted-activity days (age 18–65)	—	—	Ozone CD, Draft Ozone ISA[b]

(continued)

[Page ES-11]

Table ES-5. Human Health Effects of Pollutants Affected by the Mercury and Air Toxics Standards (continued)

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
	School absence days (age 5–17)	—	—	Ozone CD, Draft Ozone ISA[b]
	Decreased outdoor worker productivity (age 18-65)	—	—	Ozone CD, Draft Ozone ISA[b]
	Other respiratory effects (e.g., premature aging of lungs)	—	—	Ozone CD, Draft Ozone ISA[c]
	Cardiovascular and nervous system effects	—	—	Ozone CD, Draft Ozone ISA[d]
	Reproductive and developmental effects	—	—	Ozone CD, Draft Ozone ISA[d]
Reduced incidence of morbidity from exposure to NO_2	Asthma hospital admissions (all ages)	—	—	NO_2 ISA[b]
	Chronic lung disease hospital admissions (age > 65)	—	—	NO_2 ISA[b]
	Respiratory emergency department visits (all ages)	—	—	NO_2 ISA[b]
	Asthma exacerbation (asthmatics age 4–18)	—	—	NO_2 ISA[b]
	Acute respiratory symptoms (age 7–14)	—	—	NO_2 ISA[b]
	Premature mortality	—	—	NO_2 ISA[c,d]
	Other respiratory effects (e.g., airway hyperresponsiveness and inflammation, lung function, other ages and populations)	—	—	NO_2 ISA[c,d]

[Page ES-11 cont.]

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
Reduced incidence of morbidity from exposure to SO_2	Respiratory hospital admissions (age > 65)	—	—	SO_2 ISA[b]
	Asthma emergency room visits (all ages)	—	—	SO_2 ISA[b]
	Asthma exacerbation (asthmatics age 4–12)	—	—	SO_2 ISA[b]
	Acute respiratory symptoms (age 7–14)	—	—	SO_2 ISA[b]
	Premature mortality	—	—	SO_2 ISA[c,d]
	Other respiratory effects (e.g., airway hyperresponsiveness and inflammation, lung function, other ages and populations)	—	—	SO_2 ISA[c,d]
Reduced incidence of morbidity from exposure to methyl mercury (through reduced mercury deposition as well as the role of sulfate in methylation)	Neurologic effects—IQ loss	✓	✓	IRIS; NRC, 2000[b]
	Other neurologic effects (e.g., developmental delays, memory, behavior)	—	—	IRIS; NRC, 2000c
	Cardiovascular effects	—	—	IRIS; NRC, 2000[c,d]
	Genotoxic, immunologic, and other toxic effects	—	—	IRIS; NRC, 2000[c,d]

[a] For a complete list of references see Chapter 5.
[b] We assess these benefits qualitatively due to time and resource limitations for this analysis.
[c] We assess these benefits qualitatively because we do not have sufficient confidence in available data or methods.
[d] We assess these benefits qualitatively because current evidence is only suggestive of causality or there are other significant concerns over the strength of the association.

[Page ES-12]

Table ES-6. Environmental Effects of Pollutants Affected by the Mercury and Air Toxics Standards

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information[a]
Improved Environment				
Reduced visibility impairment	Visibility in Class I areas in SE, SW, and CA regions	—	—	PM ISA[b]
	Visibility in Class I areas in other regions	—	—	PM ISA[b]
	Visibility in residential areas	—	—	PM ISA[b]
Reduced climate effects	Global climate impacts from CO_2	—	✓	Section 5.6
	Climate impacts from ozone and PM	—	—	Section 5.6
	Other climate impacts (e.g., other GHGs, other impacts)	—	—	IPCC[c]
Reduced effects on materials	Household soiling	—	—	PM ISA[c]
	Materials damage (e.g., corrosion, increased wear)	—	—	PM ISA[c]
Reduced effects from PM deposition (metals and organics)	Effects on individual organisms and ecosystems	—	—	PM ISA[c]

[Page ES-12 cont.]

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information[a]
Reduced vegetation and ecosystem effects from exposure to ozone	Visible foliar injury on vegetation	—	—	Ozone CD, Draft Ozone ISA[c]
	Reduced vegetation growth and reproduction	—	—	Ozone CD, Draft Ozone ISA[b]
	Yield and quality of commercial forest products and crops	—	—	Ozone CD, Draft Ozone ISA[b,d]
	Damage to urban ornamental plants	—	—	Ozone CD, Draft Ozone ISA[c]
	Carbon sequestration in terrestrial ecosystems	—	—	Ozone CD, Draft Ozone ISA[c]
	Recreational demand associated with forest aesthetics	—	—	Ozone CD, Draft Ozone ISA[c]
	Other non-use effects			Ozone CD, Draft Ozone ISA[c]
	Ecosystem functions (e.g., water cycling, biogeochemical cycles, net primary productivity, leaf-gas exchange, community composition)	—	—	Ozone CD, Draft Ozone ISA[c]

(continued)

[Page ES-13]

Table ES-6. Environmental Effects of Pollutants Affected by the Mercury and Air Toxics Standards (continued)

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
Reduced effects from acid deposition	Recreational fishing	—	—	NO, SO, ISA[b]
	Tree mortality and decline	—	—	NO, SO, ISA[c]
	Commercial fishing and forestry effects	—	—	NO, SO, ISA[c]
	Recreational demand in terrestrial and aquatic ecosystems	—	—	NO, SO, ISA[c]
	Other nonuse effects			NO, SO, ISA[c]
	Ecosystem functions (e.g., biogeochemical cycles)	—	—	NO, SO, ISA[c]
Reduced effects from nutrient enrichment	Species composition and biodiversity in terrestrial and estuarine ecosystems	—	—	NO, SO, ISA[c]
	Coastal eutrophication	—	—	NO, SO, ISA[c]
	Recreational demand in terrestrial and estuarine ecosystems	—	—	NO, SO, ISA[c]
	Other non-use effects			NO, SO, ISA[c]
	Ecosystem functions (e.g., biogeochemical cycles, fire regulation)	—	—	NO, SO, ISA[c]
Reduced vegetation effects from ambient exposure to SO_2 and NO_x	Injury to vegetation from SO_2 exposure	—	—	NO, SO, ISA[c]
	Injury to vegetation from NO_x exposure	—	—	NO, SO, ISA[c]
Reduced incidence of morbidity from exposure to methyl mercury (through reduced mercury deposition as well as the role of sulfate in methylation)	Effects on fish, birds, and mammals (e.g., reproductive effects)	—	—	Mercury Study RTC[c,d]
	Commercial, subsistence and recreational fishing	—	—	Mercury Study RTC[c]

[a] For a complete list of references see Chapter 3.
[b] We assess these benefits qualitatively due to time and resource limitations for this analysis.
[c] We assess these benefits qualitatively because we do not have sufficient confidence in available data or methods.
[d] We assess these benefits qualitatively because current evidence is only suggestive of causality or there are other significant concerns over the strength of the association.

[Page ES-13]

Table ES-6. Environmental Effects of Pollutants Affected by the Mercury and Air Toxics Standards (continued)

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
Reduced effects from acid deposition	Recreational fishing	—	—	NO_x, SO_2, ISA[b]
	Tree mortality and decline	—	—	NO_x, SO_x, ISA[c]
	Commercial fishing and forestry effects	—	—	NO_x, SO_x, ISA[c]
	Recreational demand in terrestrial and aquatic ecosystems	—	—	NO_x, SO_x, ISA[c]
	Other nonuse effects			NO_x, SO_x, ISA[c]
	Ecosystem functions (e.g., biogeochemical cycles)	—	—	NO_x, SO_x, ISA[c]
Reduced effects from nutrient enrichment	Species composition and biodiversity in terrestrial and estuarine ecosystems	—	—	NO_x, SO_x, ISA[c]
	Coastal eutrophication	—	—	NO_x, SO_x, ISA[c]
	Recreational demand in terrestrial and estuarine ecosystems	—	—	NO_x, SO_x, ISA[c]
	Other non-use effects			NO_x, SO_x, ISA[c]
	Ecosystem functions (e.g., biogeochemical cycles, fire regulation)	—	—	NO_x, SO_x, ISA[c]

[Page ES-13 cont.]

Benefits Category	Specific Effect	Effect Has Been Quantified	Effect Has Been Monetized	More Information
Reduced vegetation effects from ambient exposure to SO_2 and NO_x	Injury to vegetation from SO_2 exposure	—	—	NO_x, SO_x ISA[c]
	Injury to vegetation from NO_x exposure	—	—	NO_x, SO_x ISA[c]
Reduced incidence of morbidity from exposure to methyl mercury (through reduced mercury deposition as well as the role of sulfate in methylation)	Effects on fish, birds, and mammals (e.g., reproductive effects)	—	—	Mercury Study RTC[c,d]
	Commercial, subsistence and recreational fishing	—	—	Mercury Study RTC[c]

[a] For a complete list of references see Chapter 5.
[b] We assess these benefits qualitatively due to time and resource limitations for this analysis.
[c] We assess these benefits qualitatively because we do not have sufficient confidence in available data or methods.
[d] We assess these benefits qualitatively because current evidence is only suggestive of causality or there are other significant concerns over the strength of the association.

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[Page 3-10]
also yielding substantial SO_2 emission reductions, but is not assumed in EPA modeling to result in mercury reductions. Since there are many avenues to reduce emissions, and because the power sector is a highly complex and dynamic industry, EPA employs IPM in order to reflect the relevant components of the power sector accurately, while also providing a sophisticated view of how the industry could respond to particular policies to reduce emissions. For more detail on how EPA models emissions from the power sector, including recent updates to include acid gases, see IPM 4.10 Supplemental Documentation for MATS.

Under MATS, EPA projects annual HCl emissions reductions of 88 percent in 2015, Hg emissions reductions of 75 percent in 2015, and $PM_{2.5}$ emissions reductions of 19 percent in 2015 from coal-fired EGUs greater than 25 MW. In addition, EPA projects SO_2 emission reductions of 41 percent, and annual CO_2 reductions of 1 percent from coal-fired EGUs greater than 25 MW by 2015, relative to the base case (see Table 3-4).[8] Mercury emission projections in EPA's base case are affected by the incidental capture in other pollution control technologies (such as FGD and SCR) as described above.

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[8] The CO_2 missions reported from IPM account for the direct CO_2 emissions from fuel combustion and CO_2 created from chemical reactions in pollution controls to reduced sulfur.

[Page 3-10 cont.]

Table 3-4. Projected Emissions of SO_2, NO_x, Mercury, Hydrogen Chloride, PM, and CO_2 with the Base Case and with MATS, 2015

		Million Tons		Mercury (Tons)	Thousand Tons		CO_2 (Million Metric Tonnes)
		SO_2	NO_x		HCl	$PM_{2.5}$	
Base	All EGUs	3.4	1.9	28.7	48.7	277	2,230
	Covered EGUs	3.3	1.7	26.6	45.3	270	1,906
MATS	All EGUs	2.1	1.9	8.8	9.0	227	2,215
	Covered EGUs	1.9	1.7	6.6	5.5	218	1,882

Source: Integrated Planning Model run by EPA, 2011

* * *

[Page 3-33]

cheaper technologies. As an example, cost estimates of the Acid Rain SO_2 trading program by Resources for the Future (RFF) and MIT's Center for Energy and Environmental Policy Research (CEEPR) have been as much as 83 percent lower than originally projected by the EPA (see Carlson et al., 2000; Ellerman, 2003). It is important to note that the original analysis for the Acid Rain Program done by EPA also relied on an optimization model like IPM. Ex ante, EPA cost estimates of roughly $2.7 to $6.2 billion[11] in 1989 were an overestimate of the costs of the program in part because of the limitation of economic modeling to perfectly anticipate technological improvement of pollution controls and economic improvement of other compliance options such as fuel switching. Ex post estimates of the annual cost of the Acid Rain 502 trading program range from $1.0 to $1.4 billion.

In recognition of this historic pattern of overestimated regulatory cost, EPA's mobile source program uses adjusted engineering cost estimates of pollution control equipment and installation costs.[12] To date, and including this analysis, EPA has not incorporated a similar approach into IPM modeling of EGU compliance with environmental constraints. As a result, this analysis may overstate costs where

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[11] 2010 Phase II cost estimate in $1995.

[12] See regulatory impact analysis for the Tier 2 Regulations for passenger vehicles (1999} and Heavy-Duty Diesel Vehicle Rules (2000).

such cost savings from as-yet untapped improvements to pollution control technologies may occur in the future. Considering the broad and complex suite of generating technologies, fuels, and pollution control strategies available to the power sector, as well as the fundamental role of operating cost in electricity dispatch, it is not possible to apply a single technology-improving "discount" transformation to the cost projections in this analysis. The Agency will consider additional methodologies in the future which may inform the amount by which projected compliance costs could be overstated regarding further technological development in analyses of power sector regulations.

As configured in this application, IPM does not take into account demand response (i.e., consumer reaction to electricity prices). The increased retail electricity prices shown in Table 3-13 would prompt end users to increase investment in energy efficiency and/or curtail (to some extent) their use of electricity and encourage them to use substitutes.[13] Those responses would lessen the demand for electricity, resulting in electricity price increases slightly lower than IPM predicts, which would also reduce generation and emissions. Demand response would yield certain unquantified cost savings from requiring less electricity to meet the quantity demanded. To some degree, these saved resource costs will offset the additional costs

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[13] The degree of substitution/curtailment depends on the costs and performance of the goods that substitute for more energy consuming goods, which is reflected in the demand elasticity.

[Page 5-15]

> Carbonaceous and crustal $PM_{2.5}$ BPT estimates were similarly generated using the co-benefits and emissions of those species.

The resulting BPT estimates (listed in Table 5C-3) were then multiplied by the projected SO_2 (1.33 million tons), carbonaceous $PM_{2.5}$ (6,100 tons), and crustal $PM_{2.5}$ (39,000 tons) emission reductions for the final policy to produce an estimate of the $PM_{2.5}$-related health impacts and monetized co-benefits. Due to time limitations, direct $PM_{2.5}$ benefits are based on direct $PM_{2.5}$ emission reductions from an earlier policy scenario. However, since direct $PM_{2.5}$ benefits contribute only approximately 5% to the total $PM_{2.5}$ health co-benefits of this rule, and differences between direct $PM_{2.5}$ emission reductions between the earlier and final policy scenarios are expected to be modest, use of earlier $PM_{2.5}$ emission changes is unlikely to materially affect the results. Additional details on the BPT methodology and derivation are given in Appendix 5C. An implicit assumption in our approach is that the size and distribution of SO_2 emissions, and the relative levels of NO_x and SO_2 emissions, are fairly similar in the modeled and revised policy cases. In general, the modeled and revised policy cases achieve rough ly similar levels of SO_2 reductions (1.42 versus 1.33 million tons, respectively) with a similar distribution among states. However, for some states (notably Alabama, Colorado, Louisiana, Michigan, Missouri, North Dakota, Oklahoma, and Texas), SO_2 emission reductions were lower for the final case versus the interim case. By far, the greatest difference in SO2 emission reductions was in Michigan where the final

case emission reduction was 70% lower than for the interim case. In a few states (notably Arkansas, Ohio, and South Carolina), SO_2 emission reductions were slightly larger for the final case versus the interim case. Since differences between the interim and final cases are not concentrated in any particular region of the country and the overall distribution of emission reductions is similar, we conclude tha. it is reasonable to apply BPT values derived from the interim case to the final case. While NO_x emissions reductions decreased by 70% between the interim and final cases (141,000 vs. 46,000 tons), the impact of NO_x on $PM_{2.5}$ concentrations and mortality is very minor relative to the impact of SO_2 emission reductions. Therefore, differences in the magnitude and distribution of NO_x emission reductions are likely to have only a minor effect on results. We did not develop ozone BPT estimates for this rule for two reasons. First, the overall level of ozone-related co-benefits in the modeled case is relatively sma ll compared to those associated with $PM_{2.5}$ reductions, due in part to the modest NO_x emission reductions. Second, the complex non-linear chemistry of ozone formation introduces uncertainty to the 5-15

[Page 4-3]

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4.2 Impact of Mercury on Human Health

4.2.1 Introduction

Mercury is a persistent, bioaccumulative toxic metal that is emitted from power plants in three forms: gaseous elemental Hg (Hg^0), oxidized Hg compounds (Hg^{+2}), and particle-bound Hg (Hg_P). Elemental Hg does not quickly deposit or chemically react in the atmosphere, resulting in residence times that are long enough to contribute to global scale deposition. Oxidized Hg and HgP deposit quickly from the atmosphere impacting local and regional areas in proximity to sources. Methylmercury (MeHg) is formed by microbial action in the top layers of sediment and soils, after Hg has precipitated from the air and deposited into waterbodies or land. Once formed, MeHg is taken up by aquatic organisms and bioaccumulates up the aquatic food web. Larger predatory fish may have MeHg concentrations many times, typically on the order of one million times, that of the concentrations in the freshwater body in which they live.

[Page 4-4]

Although Hg is toxic to humans when it is inhaled or ingested, we focus in this rulemaking on exposure to MeHg through ingestion of fish, as it is the primary route for human exposures in the U.S., and potential health risks do not likely result from Hg inhalation exposures associated with Hg emissions from utilities.

In 2000, the National Research Council (NRC) of the NAS issued the NAS Study, which provides a thorough review of the effects of MeHg on human health. There are numerous studies that have been published more recently that report effects on neurologic and other endpoints.

4.2.2 Neurologic Effects

In its review of the literature, the NAS found neurodevelopmental effects to be the most sensitive and best documented endpoints and appropriate for establishing an RfD (NRC, 2000); in particular NAS supported the use of results from neurobehavioral or neuropsychological tests. The NAS report (NRC, 2000) noted that studies in animals reported sensory effects as well as effects on brain development and memory functions and support the conclusions based on epidemiology studies. The NAS noted that their recommended endpoints for an RfD are associated with the ability of children to learn and to succeed in school. They concluded the following: "The population at highest risk is the children of women who consumed large amounts of fish and seafood during pregnancy. The committee concludes that the risk to that population is likely to be sufficient to result in an increase in the number of children who have to struggle to keep up in school."

4.2.3 Cardiovascular Impacts

The NAS summarized data on cardiovascular effects available up to 2000. Based on these and other studies, the NRC (2000) concluded that "Although the data base is not as extensive for cardiovascular effects as it is for other end points (i.e.

neurologic effects) the cardiovascular system appears to be a target for MeHg toxicity in humans and animals." The NRC also stated that "additional studies are needed to better characterize the effect of methylmercury exposure on blood pressure and cardiovascular function at various stages of life."

Additional cardiovascular studies have been published since 2000. EPA did not to develop a quantitative dose-response assessment for cardiovascular effects associated with MeHg exposures, as EPA finds there is no consensus among scientists on the dose-response

[Page 4-5]
functions for these effects. In addition, there is inconsistency among available studies as to the association between MeHg exposure and various cardiovascular system effects. The pharmacokinetics of some of the exposure measures (such as toenail Hg levels) are not well understood. The studies have not yet received the review and scrutiny of neurotoxicity studies.

4.2.4 Genotoxic Effects

The Mercury Study noted that MeHg is not a potent mutagen but is capable of causing chromosomal damage in a number of experimental systems. The NAS concluded that evidence that human exposure to MeHg caused genetic damage is inconclusive; they note that some earlier studies showing chromosomal damage in lymphocytes may not have controlled sufficiently for potential confounders. One study of adults living in the Tapajós River region in Brazil (Amorim et al., 2000)

reported a direct relationship between MeHg concentration in hair and DNA damage in lymphocytes; as well as effects on chromosomes. Long-term MeHg exposures in this population were believed to occur through consumption of fish, suggesting that genotoxic effects (largely chromosomal aberrations) may result from dietary, chronic MeHg exposures similar to and above those seen in the Faroes and Seychelles populations.

4.2.5 Immunotoxic Effects

Although exposure to some forms of Hg can result in a decrease in immune activity or an autoimmune response (ATSDR, 1999), evidence for immunotoxic effects of MeHg is limited (NRC, 2000).

4.2.6 Other Human Toxicity Data

Based on limited human and animal data, MeHg is classified as a "possible" human carcinogen by the International Agency for Research on Cancer (IARC, 1994) and in IRIS (USEPA, 2002). The existing evidence supporting the possibility of carcinogenic effects in humans from low-dose chronic exposures is tenuous. Multiple human epidemiological studies have found no significant association between Hg exposure and overall cancer incidence, although a few studies have shown an association between Hg exposure and specific types of cancer incidence (e.g., acute leukemia and liver cancer) (NAS, 2000).

[4-6]

4.3 Impact of Mercury on Ecosystems and Wildlife

4.3.1 Introduction

Deposition of mercury to waterbodies can also have an impact on ecosystems and wildlife. Mercury contamination is present in all environmental media with aquatic systems experiencing the greatest exposures due to bioaccumulation. Bioaccumulation refers to the net uptake of a contaminant from all possible pathways and includes the accumulation that may occur by direct exposure to contaminated media as well as uptake from food.

Atmospheric mercury enters freshwater ecosystems by direct deposition and through runoff from terrestrial watersheds. Once mercury deposits, it may be converted to organic methylmercury mediated primarily by sulfate-reducing bacteria. Methylation is enhanced in anaerobic and acidic environments, greatly increasing mercury toxicity and potential to bioaccumulate in aquatic foodwebs. A number of key biogeochemical controls influence the production of methylmercury in aquatic ecosystems. These include sulfur, pH, organic matter, iron, mercury "aging," and bacteria type and activity (Munthe et al.2007).

Wet and dry deposition of oxidized mercury is a dominant pathway for bringing mercury to terrestrial surfaces. In forest ecosystems, elemental mercury may also be absorbed by plants stomatally, incorporated by foliar tissues and released in litterfall (Ericksen et al., 2003). Mercury in

throughfall, direct deposition in precipitation, and uptake of dissolved mercury by roots (Rea et al., 2002) are also important in mercury accumulation in terrestrial ecosystems.

Soils have significant capacity to store large quantities of atmospherically deposited mercury where it can leach into groundwater and surface waters. The risk of mercury exposure extends to insectivorous terrestrial species such as songbirds, bats, spiders, and amphibians that receive mercury deposition or from aquatic systems near the forest areas they inhabit (Bergeron et al., 2010a, b; Cristol et al., 2008; Rimmer et al., 2005; Wada et al., 2009 & 2010).

Numerous studies have generated field data on the levels of mercury in a variety of wild species. Many of the data from these environmental studies are anecdotal in nature rather than representative or statistically designed studies. The body of work examining the effects of these exposures is growing but still incomplete given the complexities of the natural world. A large portion of the adverse effect research conducted to date has been carried out in the laboratory setting rather than in the wild; thus, conclusions about overarching ecosystem health and

[Page 4-7]
population effects are difficult to make at this time. In the sections that follow numerous effects have been identified at differing exposure levels.

4.3.2 Effects on Fish

A review of the literature on effects of mercury on fish (Crump and Trudeau, 2009) reports results for numerous species including trout, bass (large and smallmouth), northern pike, carp, walleye, salmon and others from laboratory and field studies. The effects studied are reproductive and include deficits in sperm and egg formation, histopathological changes in testes and ovaries, and disruption of reproductive hormone synthesis. These studies were conducted in areas from New York to Washington and while many were conducted by adding MeHg to water or diet many were conducted at current environmental levels.

The Integrated Science Assessment for Oxides of Nitrogen and Sulfur—Ecological Criteria (EPA, 2008) presents information regarding the possible complementary effects of sulfur and mercury deposition. The ISA has concluded that there is a causal relationship between sulfur deposition and increased mercury methylation in wetlands and aquatic environments. This suggests that lowering the rate of sulfur deposition would also reduce mercury methylation thus alleviating the effects of aquatic acidification as well as the effects of mercury on fish.

4.3.3 Effects on Birds

In addition to effects on fish, mercury also affects avian species. In previous reports (EPA, 1997 and EPA, 2005) much of the focus has been on large piscivorous species, in particular the common loon. The loon is most visible to the public during the

summer breeding season on northern lakes and they have become an important symbol of wilderness in these areas (McIntyre and Barr, 1997). A multitude of loon watch, preservation, and protection groups have formed over the past few decades and have been instrumental in promoting conservation, education, monitoring, and research of breeding loons (McIntyre and Evers, 2000, Evers, 2006). Significant adverse effects on breeding loons from mercury have been found to occur, including behavioral (reduced nest-sitting), physiological (flight feather asymmetry), and reproductive (chicks fledged/territorial pair) effects (Evers, 2008, Burgess, 2008) and reduced survival (Mitro et al., 2008). Additionally Evers et al. (2008) report that they believe that results from their study integrating the effects on the endpoints listed above and evidence from other studies the weight of evidence indicates that population-level effects negatively impacting population viability occur in parts of Maine and New Hampshire, and potentially in broad areas of the loon's range.

[Page 4-8]

Recently attention has turned to other piscivorous species such as the white ibis and great snowy egret. While considered to be fish-eating generally these wading birds have a diverse diet including crayfish, crabs, snails, insects and frogs. These species are experiencing a range of adverse effects due to exposure to mercury. The white ibis has been observed to have decreased foraging efficiency (Adams and Frederick, 2008). Additionally ibises have been shown to exhibit decreased reproductive success and altered pair behavior at

chronic exposure to levels of dietary MeHg commonly encountered by wild birds (Frederick and Jayasena, 2010). These effects include significantly more unproductive nests, male/male pairing, reduced courtship behavior (head bobbing and pair bowing) and lower nestling production by exposed males. In this study a worst-case scenario suggested by the results could involve up to a 50% reduction in fledglings due to MeHg in diet. These estimates may be conservative if male/male pairing in the wild resulted in a shortage of partners for females and the effect of homosexual breeding were magnified. In egrets mercury has been implicated in the decline of the species in south Florida (Sepulveda et al., 1999) and Hoffman (2010) has shown that egrets experience liver and possibly kidney effects. While ibises and egrets are most abundant in coastal areas and these studies were conducted in south Florida and Nevada, the ranges of ibises and egrets extend to a large portion of the United States. Ibis territory can range inland to Oklahoma, Arkansas and Tennessee. Egret range covers virtually the entire United States except the mountain west.

Insectivorous birds have also been shown to suffer adverse effects due to current levels of mercury exposure. These songbirds such as Bicknell's thrush, tree swallows and the great tit have shown reduced reproduction, survival, and changes in singing behavior. Exposed tree swallows produced fewer fledglings (Brasso, 2008), lower survival (Hallinger, 2010) and had compromised immune competence (Hawley, 2009). The great tit has exhibited reduced singing behavior and smaller song repertoire in an area of high contamination in

the vicinity of a metallurgic smelter in Flanders (Gorissen, 2005). While these effects were small and would likely have little effect on population viability in such a short-lived species.

4.3.4 Effects on Mammals

In mammals adverse effects of methylmercury exposure have been observed in mink and river otter, both fish eating species, collected in the wild in the northeast where atmospheric deposition from municipal waste incinerators and electric utilities are the largest sources (USEPA, 1999). For otter from Maine and Vermont maximum concentrations of Hg in fur nearly equal or exceed a concentration associated with mortality. Concentrations of Hg in liver for mink in Massachusetts/ Connecticut and the levels in fur from mink in Maine exceed

[Page 4-9]
concentrations associated with acute mortality (Yates, 2005). Adverse sub-lethal effects may be associated with lower Hg concentrations and consequently be more widespread than potential acute effects. These effects may include increased activity, poorer maze performance, abnormal startle reflex, and impaired escape and avoidance behavior (Scheuhammer et al., 2007).

The studies cited here provide a glimpse of the scope of mercury effects on wildlife particularly reproductive and survival effects at current exposure levels. These effects range across species from fish to mammals and spatially across a wide area of the United States. The literature is far from complete however. Much more research is required to

establish a link between the ecological effects on wildlife and the effect on ecosystem services (services that the environment provides to people) such as recreational fishing, bird watching and wildlife viewing. EPA is not, however, currently able to quantify or monetize the benefits of reducing mercury exposures affecting provision of ecosystem services adversely affected by mercury depostion.

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[Page 4-64]
{Mercury and Other HAP Benefits Analysis}

4.8.5.6 Unquantified Benefits

In addition to the uncertainties discussed above associated with the benefit analysis of reducing exposures to MeHg from recreational freshwater angling, we are unable to quantify several additional benefits, which adds to the uncertainties in the final estimate of benefits.

Table 4-20 displays the health and ecosystem effects associated with MeHg exposure that are discussed in Section 4.2.2 for which we are currently unable to quantify. We note that specifically with regard to health effects, the NRC (2000) provided the following observation: "Neurodevelopmental effects are the most extensively studied sensitive end point for MeHg exposure, but there remains some uncertainty about the possibility of other health effects at low levels of exposure. In particular, there are indications of immune and cardiovascular effects, as well as neurological effects emerging later in life, that have not been adequately studied."

[Page 65]

Table 4-8. Unquantified Health and Ecosystem Effects Associated with Exposure to Mercury

Category of Health or Ecosystem Effect	Potential Health or Ecosystem Outcomes
Neurologic Effects	Impaired cognitive development Problems with language Abnormal social development
Other Health Effects[a]	Associations with genetic, autoimmune and cardiovascular effects
Ecological Effects[a]	Survival, reproductive, behavioral, and neurological effects in wildlife (birds, fish, and mammals)

[a] These are potential effects and are not quantified because the literature is either contradictory or incomplete.

[Page 65 cont.]

In addition to the health and ecosystem effects that we are not able to quantify, we are currently unable to quantify exposures to other segments of the U.S. population including consumption of commercial seafood and freshwater fish (produced domestically as well as imported from foreign sources) and consumption of recreationally caught seafood from estuaries, coastal waters, and the deep ocean. These consumption pathways impact additional recreational anglers who are not modeled in our benefits analysis as well as the general U.S. population. Reductions in domestic fish tissue concentrations can also impact the health of foreign consumers (consuming U.S. exports). Because of technical/theoretical limitations in the science, EPA is unable to quantify the benefits associated with several of these fish consumption pathways. For example, reductions in U.S. power plant emissions will result in a lowering of the global burden of elemental mercury, which will likely produce some degree of reduction in mercury concentrations for fish sourced from the open ocean and freshwater and estuarine waterbodies in foreign countries. In the case of mercury reductions for fish in the open ocean, complexities associated with modeling the linkage between changes in air deposition of mercury and reductions in biomagnification and bioaccumulation up the food chain (including open ocean dilution and the extensive migration patterns of certain high-consumption fish such as tuna) prevent the modeling of fish obtained from the open ocean. In the case of commercial fish obtained from foreign freshwater and estuarine waterbodies, although technical challenges are associated with modeling long-range

transport of elemental mercury and the subsequent impacts to fish in these distant locations, additional complexities such as accurately modeling patterns of harvesting and their linkages to commercial consumption in the United States prevent inclusion of foreign-sourced freshwater and estuarine fish in the primary benefits analysis.

Finally, with regard to commercially-produced freshwater fish sourced in the United States (i.e., fish from catfish, bass, and trout farms), we are unable to accurately quantify

[Page 66]
effects from this consumption pathway because many of the fish farms operating in the United States use feed that is not part of the aquatic food web of the waterbody containing the fish farm (e.g., use of agricultural-based supplemental feed). In addition, many of the farms involve artificial "constructed" waterbody environments that are atypical of aquatic environments found in the regions where those farms are located, thereby limiting the applicability of Mercury Maps' assumption in linking changes to mercury deposition to changes in mercury fish tissue concentrations (e.g., waterbodies may have restricted or absent watersheds and modified aquatic chemistry, which can effect methylation rates and impact time scales for reaching steady-state mercury fish tissue concentrations following reductions in mercury deposition). Some research indicates that the recycling of water at fish farms can magnify the mercury concentration because the system does not remove mercury as it is recycled, while newly deposited mercury is added to the system. Thus,

additional research on aquaculture farms is necessary before a benefits analysis can be conducted.

Exclusion of these commercial pathways means that this benefits analysis, although covering an important source of exposure to domestic mercury emissions (recreational freshwater anglers), excludes a large and potentially important group of individuals. Recreational freshwater consumption accounts for approximately 10 to 17% of total U.S. fish consumption, and 90% is derived from commercial sources (domestic seafood, aquaculture, and imports) (EPA, 2005).

In conclusion, several unquantified benefits associated with this analysis add to the overall uncertainty in estimating total benefits. To the extent that the proposed rule will reduce mercury deposition from power plants over estuarine areas, coastal, and open ocean waters, there would be a subsequent reduction in mercury fish tissue concentrations in these different waterbodies and an associated benefit from avoided decrements in IQ and other known health and ecosystem effects.

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[Page 68]

4.9 Benefits Associated with Reductions in Other HAP than Mercury

Even though emissions of air toxics from all sources in the U.S. declined by approximately 42 percent since 1990, the 2005 National-Scale Air Toxics Assessment (NATA) predicts that most

Americans are exposed to ambient concentrations of air toxics at levels that have the potential to cause adverse health effects (U.S. EPA, 2011d).[10] The levels of air toxics to which people are exposed vary depending on where people live and work and the kinds of activities in which they engage. In order to identify and prioritize air toxics, emission source types and locations that are of greatest potential concern, U.S. EPA conducts the NATA. [11]The most recent NATA was conducted for calendar year 2005 and was released in March 2011. NATA includes four steps:

1) Compiling a national emissions inventory of air toxics emissions from outdoor sources

2) Estimating ambient and exposure concentrations of air toxics across the United States

3) Estimating population exposures across the United States

4) Characterizing potential public health risk due to inhalation of air toxics including both cancer and noncancer effects

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[10] The 2005 NATA is available on the Internet at http://www.epa.gov/ttn/atw/nata2005/.

[11] The NATA modeling framework has a number of limitations that prevent its use as the sole basis for setting regulatory standards. These limitations and uncertainties are discussed on the 2005 NATA website. Even so, this modeling framework is very useful in identifying air toxic pollutants and sources of greatest concern, setting regulatory priorities, and informing the decision making process. U.S. EPA. (2011) 2005 National-Scale Air Toxics Assessment. http://www.epa.gov/ttn/atw/nata2005/

Based on the 2005 NATA, EPA estimates that about 5 percent of census tracts nationwide have increased cancer risks greater than 100 in a million. The average national cancer risk is about 50 in a million. Nationwide, the key pollutants that contribute most to the overall cancer risks are formaldehyde and benzene.[12, 13]

Secondary formation (e.g., formaldehyde forming from other emitted pollutants) was the largest contributor to cancer risks, while stationary, mobile and background sources contribute almost equal portions of the remaining cancer risk.

[Page 69]

Noncancer health effects can result from chronic,[14] subchronic,[15] or acute[16] inhalation

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[12] Details on EPA's approach to characterization of cancer risks and uncertainties associated with the 2005 NATA risk estimates can be found at http://www.epa.gov/ttn/atw/nata1999/riskbg.html#Z2.

[13] Details about the overall confidence of certainty ranking of the individual pieces of NATA assessments including both quantitative (e.g., model-to-monitor ratios) and qualitative (e.g., quality of data, review of emission inventories) judgments can be found at http://www.epa.gov/ttn/atw/nata/roy/page16.html

[14] Chronic exposure is defined in the glossary of the Integrated Risk Information (IRIS) database (http://www.epa.gov/iris) as repeated exposure by the oral, dermal, or inhalation route for more than approximately 10% of the life span in humans (more than approximately 90 days to 2 years in typically used laboratory animal species).

[15] Defined in the IRIS database as repeated exposure by the oral, dermal, or inhalation route for more than 30 days, up to approximately 10% of the life span in humans (more than 30 days up to approximately 90 days in typically used laboratory animal species).

exposures to air toxics, and include neurological, cardiovascular, liver, kidney, and respiratory effects as well as effects on the immune and reproductive systems. According to the 2005 NATA, about three-fourths of the U.S. population was exposed to an average chronic concentration of air toxics that has the potential for adverse noncancer respiratory health effects. Results from the 2005 NATA indicate that acrolein is the primary driver for noncancer respiratory risk.

Figure 4-5 and Figure 46 depict the estimated census tract-level carcinogenic risk and noncancer respiratory hazard from the assessment. It is important to note that large reductions in HAP emissions may not necessarily translate into significant reductions in health risk because toxicity varies by pollutant, and exposures may or may not exceed levels of concern. For example, acetaldehyde mass emissions are more than double acrolein emissions on a national basis, according to EPA's 2005 National Emissions Inventory (NEI). However, the Integrated Risk Information System (IRIS) reference concentration (RfC) for acrolein is considerably lower than that for acetaldehyde, suggesting that acrolein could be potentially more toxic than acetaldehyde.[17] Thus, it is important to account for the toxicity and exposure, as well as the mass of the targeted emissions.

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[16] Defined in the IRIS database as exposure by the oral, dermal, or inhalation route for 24 hours or less.

[17] Details on the derivation of IRIS values and available supporting documentation for individual chemicals (as well as chemical values comparisons) can be found at http://cfpub.epa.gov/ncea/iris/compare.cfm.

Due to methodology and data limitations, we were unable to estimate the benefits associated with the hazardous air pollutants that would be reduced as a result of these rules.. In a few previous analyses of the benefits of reductions in HAPs, EPA has quantified the benefits of potential reductions in the incidences of cancer and non-cancer risk (e.g., U.S. EPA, 1995). In those analyses, EPA relied on unit risk factors (URF) developed through risk assessment procedures.[18] These URFs are designed to be conservative, and as such, are more likely to represent the high end of the distribution of risk rather than a best or most likely estimate of risk. As the purpose of a benefit analysis is to describe the benefits most likely to occur from a

[Page 70]
reduction in pollution, use of high-end, conservative risk estimates would overestimate the benefits of the regulation. While we used high-end risk estimates in past analyses, advice from the EPA's Science Advisory Board (SAB) recommended that we avoid using high-end estimates

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[18] The unit risk factor is a quantitative estimate of the carcinogenic potency of a pollutant, often expressed as the probability of contracting cancer from a 70-year lifetime continuous exposure to a concentration of one µg/m3 of a pollutant.

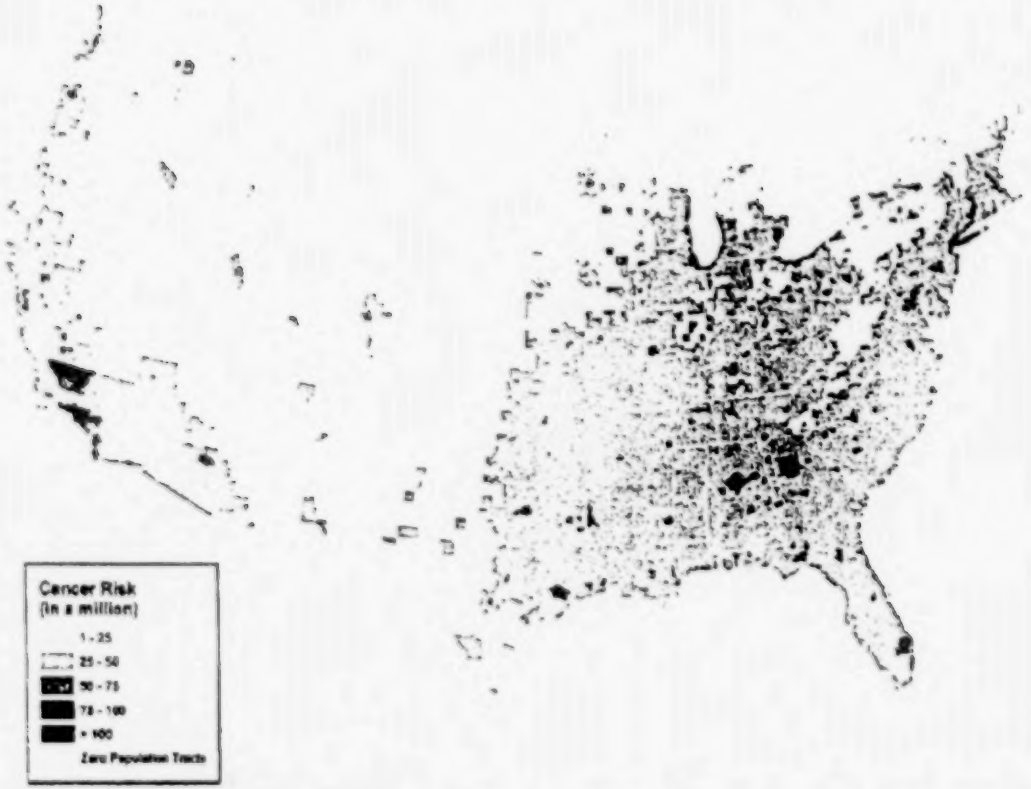

Figure 4-5. Estimated Chronic Census Tract Carcinogenic Risk from HAP Exposure from Outdoor Sources (2005 NATA)

[Page 71]

Figure 4-6. Estimated Chronic Census Tract Noncancer (Respiratory) Risk from HAP Exposure from Outdoor Sources (2005 NATA)

[Page 71 cont.]
in benefit analyses (U.S. EPA-SAB, 2002). Since this time, EPA has continued to develop better methods for analyzing the benefits of reductions in HAPs.

As part of the second prospective analysis of the benefits and costs of the Clean Air Act (U.S. EPA, 2011a), EPA conducted a case study analysis of the health effects associated with reducing exposure to benzene in Houston from implementation of the Clean Air Act (IEc, 2009). While reviewing the draft report, EPA's Advisory Council on Clean Air Compliance Analysis concluded that "the challenges for assessing progress in health improvement as a result of reductions in emissions of hazardous air pollutants (HAPs) are daunting...due to a lack of exposure-response functions, uncertainties in emissions inventories and background levels, the difficulty of extrapolating risk estimates to low doses and the challenges of tracking health progress for diseases, such as cancer, that have long latency periods" (U.S. EPA-SAB, 2008).

[Page 72]
In 2009, EPA convened a workshop to address the inherent complexities, limitations, and uncertainties in current methods to quantify the benefits of reducing HAPs. Recommendations from this workshop included identifying research priorities, focusing on susceptible and vulnerable populations, and improving dose-response relationships (Gwinn et al., 2011).

In summary, monetization of the benefits of reductions in cancer incidences requires several important inputs, including central estimates of

cancer risks, estimates of exposure to carcinogenic HAPs, and estimates of the value of an avoided case of cancer (fatal and non-fatal). Due to methodology and data limitations, we did not attempt to monetize the health benefits of reductions in HAPs in this analysis. Instead, we provide a qualitative analysis of the health effects associated with the HAPs anticipated to be reduced by these rules and we summarize the results of the residual risk assessment for the Risk and Technology Review (RTR). EPA remains committed to improving methods for estimating HAP benefits by continuing to explore additional concepts of benefits, including changes in the distribution of risk.

Available emissions data show that several different HAPs are emitted from oil and natural gas operations, either from equipment leaks, processing, compressing, transmission and distribution, or storage tanks. Emissions of eight HAPs make up a large percentage the total HAP emissions by mass from the oil and gas sector: toluene, hexane, benzene, xylenes (mixed), ethylene glycol, methanol, ethyl benzene, and 2,2,4-trimethylpentane (U.S. EPA, 2011a). In the subsequent sections, we describe the health effects associated with the main HAPs of concern from the oil and natural gas sector: benzene, toluene, carbonyl sulfide, ethyl benzene, mixed xylenes, and n-hexane. These rules combined are anticipated to avoid or reduce 58,000 tons of HAPs per year. With the data available, it was not possible to estimate the tons of each individual HAP that would be reduced.

EPA conducted a residual risk assessment for the NESHAP rule (U.S. EPA, 2011c). The results for oil and gas production indicate that maximum lifetime individual cancer risks could be 30 in-a-million for existing sources before and after controls with a cancer incidence of 0.02 before and after controls. For existing natural gas transmission and storage, the maximum individual cancer risk decreases from 90-in-a-million before controls to 20-in-a-million after controls with a cancer incidence that decreases from 0.001 before controls to 0.0002 after controls. Benzene is the primary cancer risk driver. The results also indicate that significant noncancer impacts from existing sources are unlikely, especially after controls. EPA did not conduct a risk assessment for new sources affected by the NSPS. However, it is important to note that the magnitude of the HAP emissions avoided by new sources with the NSPS are more

[Page 73]
than an order of magnitude higher than the HAP emissions reduced from existing sources with the NESHAP.

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[Page 5-1]

CHAPTER 5

HEALTH AND WELFARE CO-BENEFITS

Synopsis

Implementation of HAP emissions controls required by this rule is expected to have ancillary co-benefits, including lower overall ambient concentrations of SO_2, NO_2, $PM_{2.5}$ and ozone across the U.S. Pollutants such as SO_2, NO_x, and direct $PM_{2.5}$ contribute to ambient $PM_{2.5}$ levels in the atmosphere, and NO_x contributes to ambient ozone concentrations. Furthermore, this rule is expected to reduce CO_2 emissions affecting climate change. These health and welfare co-benefits comprise a significant share of the total monetized benefits from this rule. This chapter provides estimates for this subset of the expected annual health and climate co-benefits of this rule in 2016.

Due to limits in available air quality modeling, the quantified co-benefits of this rule consist of only $PM_{2.5}$-related health co-benefits from reductions in SO_2 (a precursor to $PM_{2.5}$ formation) and direct $PM_{2.5}$ and climate co-benefits from reductions in CO_2. These co-benefits are estimated by applying a benefit-per–ton (BPT) approach described below to estimated reductions in SO_2 and direct $PM_{2.5}$ emissions reported in Chapter 3. The monetized co-benefits assessment omits several important categories of benefits, including health and ecological co-benefits from reducing exposure to ozone, ecosystem co-benefits for reducing nitrogen and sulfate deposition, and the direct

health co-benefits from reducing exposure to ozone, SO_2 and NO_2.

We describe these co-benefits qualitatively in Section 5.5. We estimate the monetized health and climate co-benefits of MATS to be $37 billion to $90 billion at a 3% discount rate and $33 billion to $81 billion at a 7% discount rate in 2016, depending on the epidemiological function used to estimate reductions in premature mortality. All estimates are in 2007$.

5.1 Overview

The analysis in this chapter aims to characterize the co-benefits of the Mercury and Air Toxics Standards by answering two key questions:

1. What are the health effects of changes in ambient particulate matter ($PM_{2.5}$) resulting from reductions in directly-emitted $PM_{2.5}$ and SO_2?

2. What is the economic value of these effects?

* * *

[Page 5-59]

Table 5-14. Adjustment Factors Used to Account for Projected Real Income Growth[a]

Benefit Category	2016
Minor Health Effect	1.06
Severe and Chronic Health Effects	1.19
Premature Mortality	16
Visibility	1.41

[a] Based on elasticity values reported in Table 5-13, U.S. Census population projections, and projections of real GDP per capita.

5.5 Unquantified Health and Welfare Benefits

This analysis is limited by the available data and resources. As such, we are not able to quantify several welfare benefit categories, as shown in Tables 5-3 and 5-4. This section provides an overview of what is meant by ecosystem services as well as a description of visibility benefits, which are typically assessed and monetized in relevant RIAs but that were not quantified in this benefits analysis. The RIA for the final Cross-State Air Pollution Rule (U.S. EPA, 2011b) provides more information on additional major health and welfare benefit categories associated with reducing NO_2 and SO_2 emissions including: health and ecosystem benefits of reducing nitrogen and sulfur emissions and deposition; vegetation benefits from reducing ozone; mercury benefits associated with reducing mercury emissions; and the role of sulfate deposition in mercury methylation. While we are unable to quantify these benefits, previous relevant EPA assessments show that these benefits could be substantial (U.S. EPA, 2008a; U.S. EPA, 2009a; U.S. EPA, 2007; U.S. EPA, 1999, U.S. EPA, 2011b). The omission of these endpoints from the monetized results should not imply that the impacts are small or unimportant.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C. 20460

December 16, 2011

MEMORANDUM

OFFICE OF ENFORCEMENT AND COMPLIANCE ASSURANCE

SUBJECT: The Environmental Protection Agency's Enforcement Response Policy For Use Of Clean Air Act Section 113(a) Administrative Orders In Relation To Electric Reliability And The Mercury and Air Toxics Standard

FROM: Cynthia Giles, Assistant Administrator of the Office of Enforcement and Compliance Assurance

TO: Regional Administrators (Regions I-X)
Regional Counsel (EPA Regions I-X)
Regional Enforcement Division Directors (EPA Regions 1-X)
Air Division Directors (EPA Headquarters and Regions 1-X)

I. STATEMENT OF POLICY

It is the EPA's obligation to ensure compliance with environmental laws designed to protect public health and welfare. Where there is a conflict between timely compliance with a particular requirement and

electric reliability, the EPA intends to carefully exercise its authorities to ensure compliance with environmental standards while addressing genuine risks to reliability in a manner that protects public health and welfare.

Pursuant to Section 112 of the Clean Air Act ("CAA"), the EPA finalized national emission standards for hazardous air pollutants ("NESHAP") from electric generating units ("EGUs") in December 2011. These standards, commonly known as the "Mercury and Air Toxics Standards" ("MATS"), adopt emission limits on mercury, acid gases and other toxic pollutants for affected coal and oil-fired EGUs. Many existing sources will comply with the MATS by controlling their emissions, while others (typically older, smaller, less efficient units) may choose to cease operations rather than install control technologies.

The EPA believes that all affected sources will be able to comply with the MATS within the compliance period specified by Section 112(i)(3) of the CAA (including, as applicable, any extensions permitted under Section 112(i)(3)(B)) (the "MATS Compliance Date"). The EPA's analysis projects only a modest level of retirements, and the Agency does not anticipate that such retirements will lead to resource constraints that would adversely affect electric reliability.

Nonetheless, the EPA acknowledges that there may be isolated instances in which the deactivation or retirement of a unit or a delay in installation of controls due to factors beyond the owner's/operator's control could have an adverse, localized impact on

electric reliability that cannot be predicted or planned for with specificity at the present time. In such instances, sources could find themselves in the position of either operating in noncompliance with the MATS or halting operations and thereby potentially impacting electric reliability.

The EPA is issuing this policy memorandum to describe its intended approach regarding the use of Section 113(a) administrative orders ("AOs") with respect to sources that must operate in noncompliance with the MATS for up to a year to address a specific and documented reliability concern. This enforcement policy is limited in application to units that are critical for reliability purposes. Some sources will be able obtain a broadly available one-year extension pursuant to Section 112(i)(3)(B). A source that qualifies for a one year extension from its permitting authority may also qualify for an AO at the end of its extension, provided that it falls within the terms of this policy. The EPA believes that there are likely to be few, if any, cases in which it is not possible to mitigate a reliability issue within four years, and that there are likely to be fewer, if any, cases in which it is not possible to mitigate a reliability issue within the further year contemplated under this policy.

This policy does not address situations where a reliability critical unit needs more than one year to come into compliance after the MATS Compliance Date. The policy also does not address delays in installations of controls and/or other instances of noncompliance with the MATS for units that are not reliability critical. The EPA intends to handle such

scenarios as it has in the past, by assessing each situation on a case-by-case basis, at the appropriate time, to determine the appropriate enforcement response and resolution.

As set forth below, in light of the complexity of the electric system and the local nature of many reliability issues, the EPA will, for purposes of using its Section 113(a) AO authority in this context, rely for identification and/or analysis of reliability risks upon the advice and counsel of reliability experts, including, but not limited to, the Federal Energy Regulatory Commission ("FERC"), Regional Transmission Operators ("RTOs"), Independent System Operators ("ISOs") and other Planning Authorities as identified herein, the North American Electric Reliability Corporation ("NERC") and affiliated regional entities, and state public service commissions ("PSCs") and public uti lity commissions ("PUCs"). The EPA will work with these and other organizations, as appropriate, to ensure that any claims of reliability risks are properly characterized and evaluated.

The EPA is committed to achieving compliance with the MATS while ensuring electric reliability.

The policies established in this document supplement other applicable policies, and are intended to assist government personnel in determining the appropriate response to noncompliance. These policies and procedures are not intended to, nor do they, constitute a rulemaking by the EPA. These policies and procedures do not create a right or a benefit, substantive or procedural, that is enforceable at law or in equity by any p erson. The EPA reserves the

right to act at variance with these policies and to change them at any time without public notice. Further, nothing in this document should be construed to affect the EPA 's analysis of, or reaction to, an imminent and substantial endangerment to human health.

II. SUMMARY OF LEGAL REQUIREMENTS AND AUTHORITIES

Section 112 of the CAA establishes compliance deadlines for existing sources to meet standards promulgated under that provision, such as those included in the MATS rule.[1] Specifically, Section 11 2(i)(3)(A) provides:

> After the effective date of any emissions standard, limitation or regulation promulgated under this section and applicable to a source, no person may operate such source in violation of such standard, limitation or regulation except, in the case of an existing source, the Administrator shall establish a compliance date or dates for each category or subcategory of existing sources, which shall provide for compliance as expeditiously as practicable, but in no event later than 3 years after the effective date of such standard.

See, also 40 CFR 63.9984.

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[1] Except as otherwise provided under Section l 12(i)(3)(B), the MATS requires compliance within three years of the effective date, the statutory maximum.

The CAA and its implementing regulations provide specific conditions under which extensions may be granted to this three year compliance period and under which other compliance time periods may apply. *See, e.g.*, Section 112(i)(3)(B), (4)-(6). In particular, Section 11 2(i)(3)(B) provides:

> The Administrator (or a State with a program approved under subchapter V of this chapter) may issue a permit that grants an extension permitting an existing source up to I additional year to comply with standards under subsection (d) of this section if such additional period is necessary for the installation of controls.

Section 113 of the CAA authorizes the Administrator to bring enforcement actions against sources in violation of CAA requirements, seeking injunctive relief, civil penalties and, in certain circumstances, other appropriate relief. The EPA also has the discretion to agree to negotiated resolutions including, for example, expeditious compliance schedules with enforceable compliance milestones.

III. THE EPA'S ENFORCEMENT RESPONSE TO BRING RELIABILITYCRITICAL UNITS INTO COMPLIANCE

The EPA generally does not speak publicly to the intended scope of its enforcement efforts, particularly years in advance of the date when a violation may occur. The Agency is doing so now with respect to the MATS to provide confidence with respect to electric reliability. EGUs may be needed to operate to maintain the reliability of the electric grid when they

would prefer, or could be required, to halt operations temporarily (until controls can be installed) or indefinitely (through deactivation of a unit). This policy describes the EPA's intended enforcement response in such instances. The policy is informed, as are our enforcement actions in general, by the need to find an appropriate balance between critical public interests, bearing in mind the resources and process time required for any enforcement response.

Some sources may take all steps necessary to comply with the MATS, but may nevertheless be needed to operate in noncompliance with the MATS to address concerns with electric reliability. In the event that such sources are interested in receiving a schedule to come into compliance while operating, the EPA intends, where necessary to avoid a serious risk to electric reliability, and provided the criteria set forth herein are met, to issue an expeditious case-specific AO to bring a source into compliance within one year. *See* Section 113(a). Any such AOs would be issued on or after (not before) the MATS Compliance Date and would be limited to units that are required to run for reliability purposes that (A) would otherwise be deactivated, or (B) due to facto rs beyond the control of the owner/operator, have a delay in installation of controls or need to operate because another unit has had such a delay.[2]

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[2] The EPA does not intend to seek civil penalties for violations ofthe MATS that occur as a result of operation for up to one year in conformity with an AO issued in connection with this policy, unless there are misrepresentations in the materials submitted in a request for an AO.

The Agency is cognizant that early planning will play a key role in allowing for the identification, and timely mitigation, of any potential reliability issues. The EPA expects that owners/operators will begin compliance planning early, and will provide early notice of their compliance plans to the appropriate reliability entities. We further expect that entities with responsibility for reliability planning and coordination will develop and maintain system-wide reliability plans for the units within their purview, and that this regional reliability planning will provide early identification of units that are critical for reliability purposes. Early notice and planning can discourage delays in coming into compliance, encourage timely action to avoid or mitigate reliability concerns, and minimize the need for issuance of AOs of the type described herein.

The EPA also recognizes the need for advance planning with regard to the future availability of any reliability critical EGUs to operate as needed to maintain electric reliability. Accordingly, although an AO cannot be issued under Section 113(a) prior to the MATS Compliance Date, the EPA intends where the owner/operator has timely submitted a complete request and has provided appropriate cooperation- to give the owner/operator as much advance written notice as practicable of the Agency's plans with regard to such an AO.

To qualify for an AO in connection with this policy, an owner/operator should, at a minimum, take the following steps.[3,4]

A. Provide early notice of compliance plans. Within one year after the effective date of the MATS, an owner/operator should provide written notice of its compliance plans, with regard to each EGU it owns or operates, that identifies (a) the units it plans to deactivate and the anticipated dates of deactivation and (b) the units for which it intends to install pollution control equipment or otherwise retrofit and the anticipated schedule for completion of that work, to the Planning Authority for the area in which the relevant EGU or EGUs are located.[5]

B. Timely request an AO for a unit that may affect reliability due to deactivation. In addition to the elements identified in III(A)

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[3] The EPA will evaluate each request for an AO for a unit that is required to run for reliability purposes on a case-by-case basis.

[4] Any notice, request or other submission discussed in this memorandum should conform to the standard business practice of the receiving entity for the submission of information, including any requirements governing submission of Confidential Business Information and/or other confidential information.

[5] Planning Authority is the entity defined as such in the "Glossary of Terms Used in NERC Reliability Standards," available at: http://www.nerc.com/doc/standards/rs/Reliability Standards Complete Set.pdf, or any successor term thereto approved by FERC, and includes, in relevant jurisdictions, RTOs and ISOs.

above, for a unit that is required to run for reliability purposes that would otherwise be deactivated:

1. An owner/operator should, no less than 180 days prior to the MATS Compliance Date, submit electronically to (a) the Director of the Air Enforcement Division in the EPA's Office of Enforcement and Compliance Assurance, and (b) the Regional Administrator of the EPA Region in which the EGU is located, with a copy to FERC, at an office of its designation, (collectively, "AO Request Recipients") a written request for an enforceable compliance schedule in an AO for the unit, which includes information responsive to each of the elements specified in III(D) below.

2. At the same time the unit owner/operator submits its request for an AO, an owner/operator should also provide notice that it is seeking such an AO to (a) the Planning Authority, (b) any state PUCs/PSCs with regulatory jurisdiction with regard to the relevant EGU,[6] (c) any state, tribal or local environmental agency with permitting authority under Titles I and V of the CAA, and any tribal environmental agency that does not have such authority, with jurisdiction over the

[6] PUCs/PSCs may also wish to obtain the information identified in III(A), either by requesting that an owner/operator over which the PUC/PSC has jurisdiction provide such information directly, or by requesting such information from the relevant Planning Authority.

area in which the EGU is located (collectively, "AO Notice Recipients").

C. Timely request an AO for a unit that may affect reliability due to delays related to the installation of controls. In addition to the elements identified in III(A) above, for a unit that that is required to run for reliability purposes that, due to factors beyond the control of the owner/operator, has a delay in installation of controls or needs to operate because another unit has had such a delay:

1. An owner/operator should, within a reasonable time of learning of a delay that it believes may result in a unit being unable to comply by the MATS Compliance Date, provide to the Planning Authority for the area in which the relevant EGU or EGUs are located, written notice of the units impacted by the delay, the cause of the delay, an estimate of the length of time of the delay, and the timeframe during which it contemplates operation in noncompliance with the MATS.

2. An owner/operator should, within a reasonable time of learning that it is critical to reliability to operate a unit described in the preceding paragraph in noncompliance with the MATS after the MATS Compliance Date, submit electronically to the AO Request Recipients a written request for an enforceable compliance schedule in an AO for the unit, which includes information responsive to as many of the elements specified in III(D) below as it is possible to provide at that time.

3. At the same time the unit owner/operator submits its request for an AO, an owner/operator should also provide notice that it is seeking such an AO to the AO Notice Recipients.

D. Submit a complete request for an AO. The following elements should be included in a request for an AO in connection with this policy:[7]

1. Copies of the early notice provided to the Planning Authority pursuant to III(A) or an explanation of why it was not practicable to have provided such notice and a demonstration that such notice was provided as soon as it was practicable.

2. Written analysis of the reliability risk if the unit were not in operation, which demonstrates that operation of the unit after the MATS Compliance Date is critical to maintaining electric reliability, and that failure to operate the unit would: (a) result in the violation of at least one of the reliability criteria required to be filed with FERC, and, in the case of the Electric Reliability Council of Texas ("ERCOT"), with the Texas PUC,[8] or (b)

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[7] The EPA may request additional information from the unit owner/operator. The speed with which the EPA evaluates a request and its ultimate response will be related to the timeliness, completeness, and quality of the submittal.

[8] Because ERCOT oversees intrastate transmission of electricity solely within Texas and does not provide for

cause reserves to fall below the required system reserve margin.

3. Written concurrence with the analysis in III(D)(2) by, or a separate and equivalent analysis by, the Planning Authority for the area in which the relevant EGU or EGUs are located, or, in the alternative, a written explanation of why such concurrence or separate and equivalent analysis cannot be provided, and, where practicable, any related system wide analysis by such entity.

4. Copies of any written comments from third parties directed to, and received by, the owner/operator in favor of, or opposed to, operation of the unit after the MATS Compliance Date.

5. A plan to achieve compliance with the MATS no later than one year after the MATS Compliance Date, and, where practicable, a written demonstration of the plan to resolve the underlying reliability problem and the steps and timeframe for implementing it, which demonstrates that such resolution cannot be effected on or before the MATS Compliance Date.

6. An identification of the level of operation of the unit that is required to avoid the documented reliability risk in III(D)(2) and, consistent with that level, a proposal for

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interstate transmission, ERCOT files reliability criteria with the Texas PUC.

> operational limits and/or work practices to minimize or mitigate any HAP emissions to the extent practicable during any operation not in full compliance with the MATS.

In evaluating a request for an AO submitted in contemplation of this policy, although the EPA's issuance of an AO is not conditioned upon the approval or concurrence of any entity, the EPA intends to consult, as necessary or appropriate on a case-by-case basis, with FERC and/or other entities with relevant reliability expertise.

MEMORANDUM

Date: December 16, 2011
Subject: Emission Reduction Costs for Beyond-the-floor Mercury Rate for Existing Units Designed to Burn Low Rank Virgin Coal

From: Kevin Culligan, SPPD/OAQPS
To: EPA-HQ-OAR-2009-0234

For the final rule; EPA has recalculated the beyond the floor control costs for existing units designed to burn low rank virgin coal using a methodology similar to that used in the IPM analysis done for the MATS proposal. In the final rule, we have not recalculated control costs based on the other methodology used in the proposal which used ACI capital and operating costs provided in the ICR. We have not used that approach because it was based upon an assumption that all units would need to have a baghouse (also known as a fabric filter – FF – either existing or newly installed) in order to meet the MACT PM standard and that the ACI would be used with the baghouse. EPA has considered and used additional information demonstrating that high levels of mercury removal can be achieved with injection of brominated activated carbon and the addition of a FF is not necessary. Furthermore, based on additional analysis related to the PM standard, EPA believes that most lignite units will not need to install new FF, therefore, EPA believes a costing methodology based on this assumption would be inappropriate.

For this analysis, EPA calculated beyond-the-floor costs for mercury controls by assuming injection of brominated activated carbon at a rate of 3.0 lb/MACF for units with ESPs and injection rates of 2.0 lb/MACF for units with baghouses (also known as fabric filters). The rate of 2.0 lb/MACF for fabric filters is consistent with the rate assumed in all other IPM analyses for this rule. The rate of 3.0 lb/MACF for units with ESPs is lower than the rate of 5.0 lb/MACF assumed in the IPM analysis. EPA believes that this rate is appropriate, because a higher rate would likely result in reductions beyond those needed to meet the BTF standard of 4.0 lb/TBtu. Figure 1 in "Activated Carbon Injection for Mercury: Overview"[1] suggests that > 90% control can be achieved at lignite-fired units at a < 2.0 lb/MACF injection rate for units with installed FF and using treated (i.e., brominated) AC. The figure also suggests that > 90% Hg control can be achieved at lignite-fired units at < 3.0 lb/MACF injection rate for units with installed ESPs and using treated AC. As Table 1 below shows, based on the IPM analysis, all units would need to achieve reductions of less than 90%, therefore lower assumed injection rates are appropriate.

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[1] *Fuel Processing Technology* 89 (2010) 1310

Table 1 – Emission Reduction Rates Required to Meet Standard of 4 lb/TBtu.

Plant Name	Unit ID	Hg Controls	Existing Controls	Base Hg lbs/Tbtu	Reduction Required, %	Policy Hg lbs/Tbtu
Big Brown	1	ACI	Cold-side ESP + Fabric Filter + SNCR	9.09	55.98	1.01
Big Brown	2	ACI	Cold-side ESP + Fabric Filter + SNCR	9.09	55.98	1.01
Lewis & Clark	B1	ACI	Wet Scrubber	7.68	47.92	0.75
Martin Lake	1	ACI	Cold-side ESP + Wet Scrubber	5.41	26.09	0.56
Martin Lake	2	ACI	Cold-side ESP + Wet Scrubber	5.41	26.09	0.56
Martin Lake	3	ACI	Cold-side ESP + Wet Scrubber	5.41	26.09	0.56
Monticello	3	ACI	Cold-side ESP + SNCR + Wet Scrubber	6.30	36.53	0.96
R M Heskett	B1		Cold-side ESP	7.81	48.77	0.45
R M Heskett	B2		Cold-side ESP + Cyclone	4.76	16.00	0.75
Leland Olds	1		Cold-side ESP	7.68	47.93	0.77
Leland Olds	2		Cold-side ESP	7.81	48.77	0.78
Milton R Young	B1		Cold-side ESP + SCR + Wet Scrubber	4.21	4.93	0.75
Milton R Young	B2		Cold-side ESP + SCR + Wet Scrubber	4.21	4.93	0.75
Stanton	1		Cold-side ESP	7.81	48.77	0.78
Stanton	10		Fabric Filter + Dry Scrubber	7.51	46.76	0.75
Limestone	LIM1		Cold-side ESP + Wet Scrubber	6.75	40.76	1.13
Limestone	LIM2		Cold-side ESP + Wet Scrubber	6.75	40.76	1.13
Dolet Hills	1		Cold-side ESP + Wet Scrubber	8.33	51.98	1.35
Coal Creek	1		Cold-side ESP + Wet Scrubber	4.21	5.07	0.76
Coal Creek	2		Cold-side ESP + Wet Scrubber	4.21	5.07	0.76
Laramie River Station	1		Cold-side ESP + Wet Scrubber	5.31	24.71	0.56
Laramie River Station	2		Cold-side ESP + Wet Scrubber	5.31	24.71	0.56
Antelope Valley	B1		Fabric Filter + Dry Scrubber	7.51	46.76	0.75
Antelope Valley	B2		Fabric Filter + Dry Scrubber	7.51	46.76	0.75
Twin Oaks Power One	U1		Fabric Filter	5.82	31.33	1.35
Twin Oaks Power One	U2		Fabric Filter	5.82	31.33	1.35
Pirkey	1		Cold-side ESP + Wet Scrubber	7.59	47.27	1.35
Coyote	B1		Fabric Filter + Dry Scrubber	7.64	47.66	0.75
Great River Energy Spiritwood Station	1		Cold-side ESP + Fabric Filter + SNCR + Dry Scrubber	7.68	47.92	0.75

EPA also assumed a disposal cost of $25/ton for ash comingled with activated carbon. This cost is consistent with a range of studies. DOE/NETL, in a recent study examining the costs of ACI, assumed total disposal costs of $17/ton for non-hazardous fly ash. They assumed $35/ton for fly ash that would have otherwise been sold for beneficial reuse (lost revenue of $18/ton plus disposal costs of $17/ton for non-hazardous fly ash).[2] In an EPA study, $25 $30 per ton were assumed as total disposal costs.[3]

EPA recently modeled site-specific disposal costs for the RIA[4] for the proposed rule regulating coal combustion residuals (CCRs), including fly ash. Those costs were examined for units burning low rank virgin coal. The disposal costs varied by state/region. For Texas the incremental costs attributable to Hg control were $18.13/ton, while for North Dakota and Montana, the incremental costs attributable to Hg control were $32.31/ton.

Based on these key assumptions, EPA projects an average reduction cost of $27,017 per pound of Hg removed. Unit by unit costs are provided in Table 2.

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[2] *Environmental Sci. Technol.* 2007, 41, 1365].

[3] *Environmental Sci. Technol.* 2006, 1385

[4] Regulatory Impact Analysis For EPA's Proposed RCRA Regulation Of Coal Combustion Residues (CCR) Generated by the Electric Utility Industry. Prepared by US Environmental Protection Agency Office of Resource Conservation & Recovery (ORCR) (formerly Office of Solid Waste) 1200 Pennsylvania Avenue NW (Mailstop 5305P) Washington DC, 20460 USA. Available at http://www.regulations.gov/ docket number EPA-HQ-RCRA- 2009-0640-0003, Appendix H.

Table 2 – Unit by unit cost estimates for achieving an emission rate of 4 lb/TBtu Hg

Plant Name	Unit ID	Capacity (MW)	Heat Rate (Btu/kWh)	Existing PM Controls	(Base to Policy) Hg remv'd (lbm)	(2007$) unit $/lbm Hg	Total Cost
Big Brown	1	575	11001	Cold-side ESP + Fabric Filter + SNCR	-396	3954	1565723
Big Brown	2	575	10931	Cold-side ESP + Fabric Filter + SNCR	-393	3980	1565723
Lewis & Clark	B1	52.3	13787	Wet Scrubber	-31	22920	704682
Martin Lake	1	750	11512	Cold-side ESP + Wet Scrubber	-332	32175	10671737
Martin Lake	2	750	11202	Cold-side ESP + Wet Scrubber	-323	32174	10383770
Martin Lake	3	750	10784	Cold-side ESP + Wet Scrubber	-311	32309	10038209
Monticello	3	750	11246	Cold-side ESP + SNCR + Wet Scrubber	-359	29249	10487787
R M Heskett	B1	29.37	11985	Cold-side ESP	-17	38871	652353
R M Heskett	B2	75.5	11386	Cold-side ESP + Cyclone	-22	53992	1206545
Leland Olds	1	221	11404	Cold-side ESP	-109	25792	2812406
Leland Olds	2	448	11021	Cold-side ESP	-217	23822	5176973
Milton R Young	B1	250	10661	Cold-side ESP + SCR + Wet Scrubber	-64	51542	3272935
Milton R Young	B2	455	10661	Cold-side ESP + SCR + Wet Scrubber	-116	49018	5665257
Stanton	1	130.3472	10990	Cold-side ESP	-77	26601	2050240

Stanton	10	57.35278	10320	Fabric Filter + Dry Scrubber	-31	30538	935770.1
Limestone	LIM1	831	10102	Cold-side ESP + Wet Scrubber	-372	29034	10797361
Limestone	LIM2	858	10108	Cold-side ESP + Wet Scrubber	-384	28982	11134608
Coal Creek	1	554	11219	Cold-side ESP + Wet Scrubber	-162	48056	7781365
Coal Creek	2	560.3	10818	Cold-side ESP + Wet Scrubber	-158	47982	7576786
Laramie River Station	1	565	11312	Cold-side ESP + Wet Scrubber	-235	34742	8170580
Laramie River Station	2	570	10953	Cold-side ESP + Wet Scrubber	-230	34737	7980115
Antelope Valley	B1	450	10988	Fabric Filter + Dry Scrubber	-264	22315	5888636
Antelope Valley	B2	450	11206	Fabric Filter + Dry Scrubber	-269	22269	5993120
Twin Oaks Power One	U1	152	9497	Fabric Filter	-50	38215	1900963
Twin Oaks Power One	U2	153	10364	Fabric Filter	-55	37778	2064287
Coyote	B1	427	11639	Fabric Filter + Dry Scrubber	-228	22122	5043515
Pirkey	1	675	10693	Cold-side ESP + Wet Scrubber	-349	26185	9140141
Great River Energy Spiritwood Station	1	99	8937	Cold-side ESP + Fabric Filter + SNCR + Dry Scrubber	-46	11694	535381.6
Dolet Hills	1	650	10674	Cold-side ESP + Wet Scrubber	-351	27064	9500464
				Total	-5948		1.61E+08
				Average		27016	

Emission Reduction Costs for the Beyond-the-Floor Mercury Rate in the Toxics Rule

EPA's IPM modeling of beyond-the-floor (BTF) mercury reduction from subcategorized units subject to the proposed Toxics Rule projects two methods for compliance: fuel switching from lignite to subbituminous coal or retrofitting of activated carbon injection systems. This technical support document (TSD) presents the modeled ACI retrofit costs and incremental fuel switching costs from the proposed Toxics Rule policy case analysis. The estimated compliance cost can be compared with the projected mercury reductions to consider the cost-effectiveness on a cost-perton basis for beyond-the-floor mercury reductions from these subcategorized units.

Fuel Switching costs (based on IPM modeling of unit coal choice):

EPA's IPM modeling of the proposed Toxics Rule projects that about 4.7 GW of capacity would switch from lignite to sub-bituminous fuel to meet the subcategorized beyond-the-floor mercury emissions rate standard, at a total incremental fuel cost (weighted by generation changes) of about $24.8 million (in 2007-year dollars). These units collectively achieve about a 1,580-lb reduction in mercury emissions from the base case; therefore, the average emission reduction cost from fuel-switching at these units is about $15,696 per lb Hg removed.

Subcategorized Capacity Projected to Switch Coal	Incremental Generation	Incremental Fuel Cost	Generation-Weighted Incremental Fuel Cost	Mercury Reduction	Cost of Mercury Removed
4.7 GW	-65 GWh	$23.9 million	$24.8 million	1,580 lbs	$15,696/lb

ACI Retrofit Costs (based on IPM modeling assumptions derived from Sargent & Lundy engineering analysis):

For units adopting ACI retrofits, this cost analysis is weighted based on whether the retrofitting capacity has a pre-existing fabric filter (IPM includes separate ACI retrofit options with and without Toxecon on this basis).

EPA's IPM modeling projects that about 3.2 GW of capacity would adopt ACI with Toxecon to meet the subcategorized beyond-the-floor mercury emissions rate standard, at a total annualized retrofit cost of about $2.34 million (in 2007-year dollars). This analysis excludes capital costs for installing the Toxecon fabric filter system on the basis of its use for PM control under the Toxics Rule. The representative unit shown in the table below achieves a 180.9-lb reduction in mercury emissions from the base case at an annualized retrofit cost of $2.34 million; therefore, the average emission reduction cost from ACI retrofitting at these units is about $12,935 per lb Hg removed. The proposed Toxics Rule modeling also projects that 2.2 GW of capacity with existing fabric filters would adopt ACI without Toxecon; the representative unit in this category would incur a total annualized retrofit cost of about $5.09 million while achieving about 111.2 lbs of mercury emission reductions for an average cost of $45,773/lb reduced.

Type of Retrofit	ACI with Toxecon	ACI without Toxecon
Subcategorized Capacity	3.2 GW	2.2 GW
Average Capacity per Unit	451 MW	247 MW
Average Capital Cost (excluding fabric filter)	$9 /kW	$13 /kW
Average Fixed Operation & Maintenance Cost	$0.57 /kW	$0.06 /kW
Average Variable Operation & Maintenance Cost	$0.48 /MWh	$2.56 /MWh
Total Annualized Cost of Retrofit	$2.34 million	$5.09 million
Mercury Reduction	180.9 lbs	111.2 lbs
Cost of Mercury Removed	$12,935/lb	$45,773/lb

(calculations assume an 85% capacity factor and a capital charge rate of 11.4%)

Average Cost-Effectiveness of Mercury Reduced for Beyond-the-Floor

Compliance Strategy	Estimated Annual Mercury Reductions	Estimated Annual Costs
Coal-Switching	1,580 lbs	$24.8 million
Retrofit ACI with Toxecon	1,284 lbs	$16.6 million
Retrofit ACI without Toxecon	990 lbs	$45.3 million
Total	**3,854 lbs**	**$86.7 million**

Based on total estimated mercury reductions and annual costs in the table above, the average removal cost for mercury emissions from these subcategorized units fuel-switching and retrofitting with ACI is estimated to be $22,496/lb. Based on these results, EPA believes that the projected compliance behavior for the subcategorized capacity under the proposed Toxics Rule would yield cost-effective mercury reductions at the beyond-the-floor emissions rate standard.